

Western Snowy Plover
(*Charadrius alexandrinus nivosus*)

Pacific Coast Population

Draft Recovery Plan

(May 2001)

U.S. Fish and Wildlife Service
Region 1

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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DISCLAIMER

Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. We, the Fish and Wildlife Service, publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, State agencies, and others. Recovery teams serve as independent advisors to the Fish and Wildlife Service. Objectives of the plan will be attained and necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate cooperating or other parties to undertake specific tasks, and may not represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than our own. They represent our official position **only** after they have been signed by the Director, Regional Director, or Operations Manager as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

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EXECUTIVE SUMMARY

CURRENT SPECIES STATUS: The Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*) is federally listed as threatened. The current Pacific coast breeding population extends from Damon Point, Washington, to Bahia Magdalena, Baja California, Mexico. The snowy plover winters mainly in coastal areas from southern Washington to Central America.

HABITAT REQUIREMENTS AND LIMITING FACTORS: The Pacific coast population of western snowy plovers breeds primarily above the high tide line on coastal beaches, sand spits, dune-backed beaches, sparsely-vegetated dunes, beaches at creek and river mouths, and salt pans at lagoons and estuaries. Less common nesting habitats include bluff-backed beaches, dredged material disposal sites, salt pond levees, dry salt ponds, and river bars. In winter, snowy plovers are found on many of the beaches used for nesting as well as on beaches where they do not nest, in man-made salt ponds, and on estuarine sand and mud flats.

Habitat degradation caused by human disturbance, urban development, introduced beachgrass (*Ammophila* spp.), and expanding predator populations have resulted in a decline in active nesting areas and in the size of the breeding and wintering populations.

RECOVERY OBJECTIVE: The primary objective of this recovery plan is to remove the Pacific coast western snowy plover population from the *List of Endangered and Threatened Wildlife and Plants* by: (1) achieving well-distributed increases in numbers and productivity of breeding adult birds, and (2) providing for long-term protection of breeding and wintering plovers and their habitat.

RECOVERY PRIORITY: 3C, per criteria published by Federal Register Notice (48 FR 43098; September 12, 1983).

RECOVERY CRITERIA: The Pacific coast population of the western snowy plover will be considered for delisting when the following criteria have been met:

1. Maintain for 10 years an average of 3,000 breeding adults distributed among 6 recovery units as follows: Washington and Oregon, 250 breeding adults; Del Norte to Mendocino Counties, California, 150 breeding adults; San Francisco Bay, California, 500 breeding adults; Sonoma to Monterey Counties, 400 breeding adults; San Luis Obispo to Ventura Counties, California, 1,200 breeding adults; and Los Angeles to San Diego Counties, California, 500 breeding adults.
2. Maintain a 5-year average productivity of at least 1.0 fledged chick per male in each recovery unit in the last 5 years prior to delisting.
3. Have in place participation plans among cooperating agencies, landowners, and conservation organizations to assure protection and management of breeding, wintering, and migration areas listed in Appendix B to maintain the subpopulation sizes and average productivity specified in criteria 1 and 2 above.

ACTIONS NEEDED:

1. Monitor and manage breeding habitat of the Pacific coast population of the western snowy plover to maximize survival and productivity.
2. Monitor and manage wintering and migration areas to maximize snowy plover population survival.
3. Develop mechanisms for long-term management and protection of snowy plovers and their breeding and wintering habitat.
4. Undertake scientific investigations that facilitate recovery efforts.
5. Undertake public information and education programs.
6. Review progress towards recovery annually and revise recovery efforts as appropriate.

7. Dedicate U.S. Fish and Wildlife Service staff and funding for the Sacramento Fish and Wildlife Office to coordinate recovery implementation.

8. Establish an international conservation program with the government of Mexico to protect snowy plovers and their breeding and wintering locations in Mexico.

Appendix J addresses Actions 1 and 2, providing guidelines for monitoring snowy plovers during the breeding and wintering seasons. Appendix K addresses Action 5, providing a public information and education plan.

ESTIMATED COST OF RECOVERY: \$28,588,000 plus additional costs that cannot be estimated at this time.

DATE OF RECOVERY: Delisting could occur by 2025 if recovery criteria have been met.

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I. INTRODUCTION

On March 5, 1993, the Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*) was listed as threatened under provisions of the Endangered Species Act of 1973 (16 U.S.C., 1531-1544), as amended (U.S. Fish and Wildlife Service 1993a). This population breeds primarily on coastal beaches from southern Washington to southern Baja California, Mexico (Figure 1). General locations of the snowy plover's breeding and wintering locations are shown in Appendix A. Recent surveys, status reviews, and literature searches have identified 157 current or historical snowy plover breeding or wintering locations on the U.S. Pacific coast. These localities include 5 in Washington, 19 in Oregon, and 133 in California (Appendix B). In Baja California, breeding plovers concentrate at coastal wetland complexes as far south as Bahia Magdalena, Mexico (Palacios *et al.* 1994). The locations listed in Appendix B are important for the recovery of the United States Pacific coast population of the western snowy plover.

In Washington, the western snowy plover was listed as endangered under Washington Department of Game Policy #402 in 1981. The State endangered status was reaffirmed in 1990 by the Washington Wildlife Commission (Washington Administrative Code 232-12-014). In Oregon, the western snowy plover was listed as a threatened species by the Oregon Fish and Wildlife Commission in 1975. Its threatened status was reaffirmed in 1989 under the Oregon Endangered Species Act during the review required by Oregon Revised Statutes 496.176(7)(b). The Oregon Fish and Wildlife Commission confirmed the species' threatened status as part of its periodic review in December 1993, and again in December 1998. The Oregon Endangered Species Act was amended through House Bill 2120 in 1995 and was implemented by administrative rule in January 1998. The western snowy plover conservation program adopted in 1994 provides "survival guidelines" for this species under this amended rule. In California, the western snowy plover has been classified by the California Department of Fish and Game as a "species of special concern" throughout all of

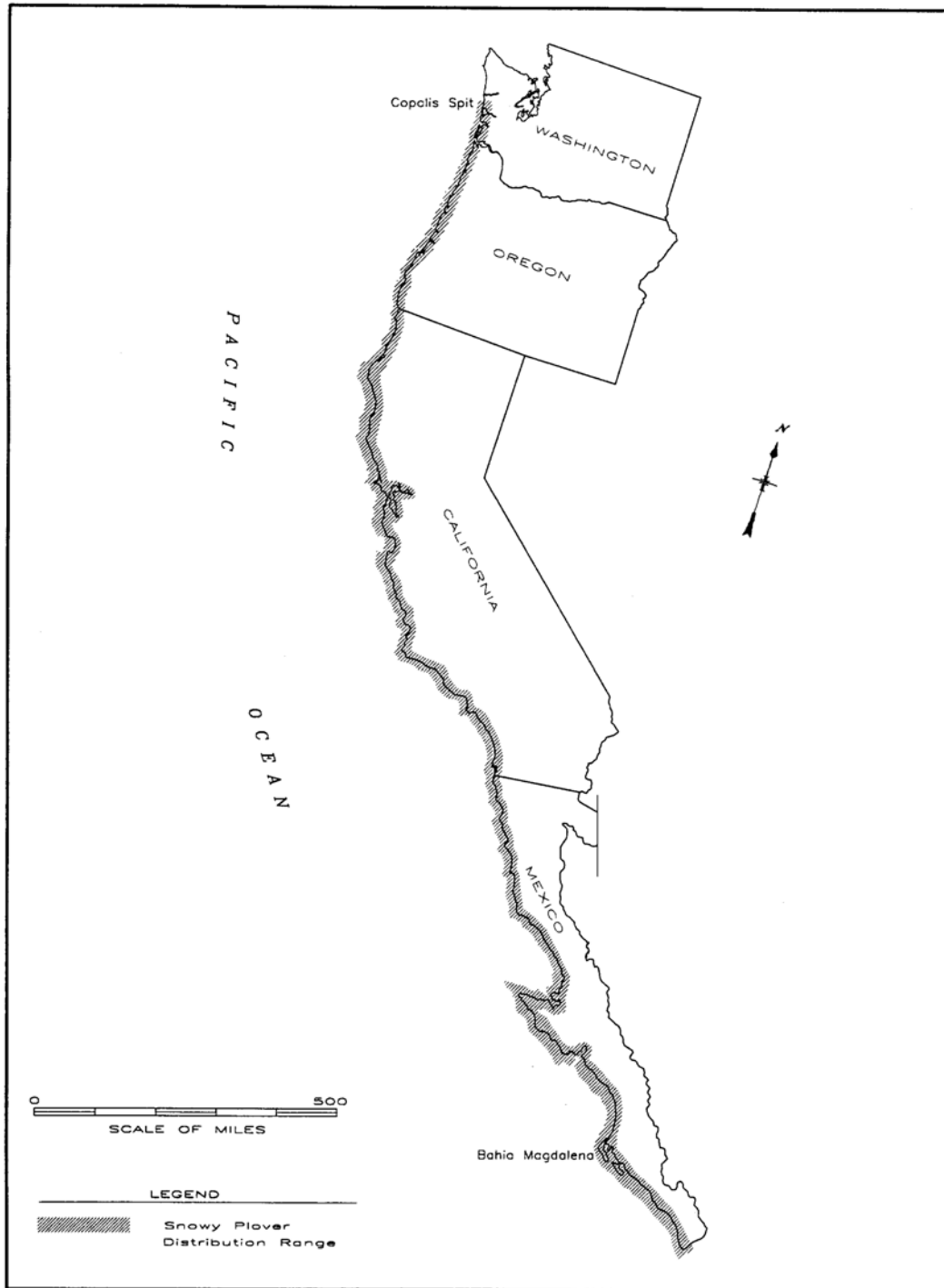


Figure 1. Map of known breeding and wintering distribution of the Pacific coast population of the western snowy plover.

California since 1978 (Remsen 1978, California Natural Diversity Database 2001).

Under section 4 of the Endangered Species Act of 1973, as amended, the U.S. Fish and Wildlife Service is required to develop a recovery plan after a species is federally listed as threatened or endangered, unless it is determined that such a plan will not promote the conservation of the species. Recovery is the process that reverses the decline of a listed species, neutralizes threats, and ensures the species' long-term survival. This recovery plan recommends actions necessary to satisfy the biological needs and assure recovery of the Pacific coast population of the western snowy plover. These actions include protection, enhancement, and restoration of all habitats deemed important for recovery; monitoring; research; and public outreach.

This recovery plan will serve as a guidance document for interested parties including Federal, State, and local agencies, private landowners, and the general public. It includes recommendations for plover management measures for all known breeding and wintering locations (Appendix C). These locations have been divided into six recovery units, as follows: (1) Oregon and Washington; (2) northern California (Del Norte, Humboldt, and Mendocino Counties); (3) San Francisco Bay (locations within the counties of Napa, Alameda, Santa Clara, and San Mateo); (4) Monterey Bay (including coastal areas along counties of Monterey, Santa Cruz, San Mateo, San Francisco, Marin, and Sonoma); (5) San Luis Obispo, Santa Barbara, and Ventura Counties; and (6) Los Angeles, Orange, and San Diego Counties). Designation of these locations and recovery units assists in identifying priority areas for conservation planning across the snowy plover's breeding and wintering range.

This recovery plan emphasizes opportunities for improved management on Federal and State lands. Improved management on these lands will incur long-term costs to these public land managers and restrict public use on some habitat areas. Public support and involvement will be crucial to the recovery of the western snowy plover. The nesting season of the snowy plover includes the period of greatest public recreational use of beaches (Memorial Day through Labor Day). This recovery plan is a call to action to the public for snowy plover

conservation. Opportunities for public participation in recovery efforts are emphasized in Appendix K (Information and Education Plan). This recovery plan provides a strategy for recovery of the entire Pacific coast population of the western snowy plover, although site-specific recommendations are limited to the populations within its United States range.

A. DESCRIPTION AND TAXONOMY

The snowy plover, a small shorebird in the family Charadriidae, weighs from 34 to 58 grams (1.2 to 2 ounces) and ranges in length from 15 to 17 centimeters (5.9 to 6.6 inches) (Page *et al.* 1995a). It is pale gray-brown above and white below, with a white hindneck collar and dark lateral breast patches, forehead bar, and eye patches (see Figure 2). The bill and legs are blackish. In breeding plumage,



Figure 2. Adult male snowy plover (photo by Peter Knapp, with permission).

males usually have black markings on the head and breast; in females, usually one or more of these markings are dark brown. Early in the breeding season, a rufous crown is evident on breeding males, but not on females. In nonbreeding plumage, sexes cannot be distinguished because the breeding markings disappear. Fledged juveniles have white edges on their wing coverts and scapulars and can thus be

distinguished from adults until approximately July through October, depending on when the eggs hatch. During this period, molt and feather wear makes fledged juveniles indistinguishable from adults. The mean annual life span of snowy plovers is about 3 years, but at least one individual was at least 15 years old when last seen (Page *et al.* 1995a).

The species was first described in 1758 by Linnaeus (American Ornithologists' Union 1957). Two subspecies of the snowy plover have been recognized in North America (American Ornithologists' Union 1957): the western snowy plover (*Charadrius alexandrinus nivosus*) and the Cuban snowy plover (*C. a. tenuirostris*). The western snowy plover breeds on the Pacific coast from southern Washington to southern Baja California, Mexico, and in interior areas of Oregon, California, Nevada, Utah, New Mexico, Colorado, Kansas, Oklahoma, and north-central Texas, as well as coastal areas of extreme southern Texas, and possibly extreme northeastern Mexico (American Ornithologists' Union 1957). Although previously observed only as a migrant in Arizona, small numbers have bred there in recent years (Monson and Phillips 1981, Davis and Russell 1984). The Cuban snowy plover (*C. a. tenuirostris*) breeds along the Gulf coast from Louisiana to western Florida and south through the Caribbean (American Ornithologists' Union 1957). More recent works recognize only subspecies *C. a. nivosus* for North America (Hayman *et al.* 1986, Binford 1989, Sibley and Monroe 1990).

The Pacific coast population of the snowy plover is defined as those individuals that nest on the mainland coast, peninsulas, offshore islands, bays, estuaries, or rivers of the United States Pacific coast and Baja California, Mexico (U.S. Fish and Wildlife Service 1993a).

A large amount of breeding data indicates that the Pacific coast population of the western snowy plover is distinct from western snowy plovers breeding in the interior (U.S. Fish and Wildlife Service 1993a). Snowy plovers tend to be site faithful, with the majority of birds returning to the same nesting location in subsequent years (Warriner *et al.* 1986). Intensive banding and monitoring studies have documented only two clear instances of interbreeding between coastal and interior populations, but there have been observations of four other birds that may have been interbreeding. First, a banded female hatched at

Monterey Bay was observed nesting the following year at Mono Lake, California (G. Page *in litt.* 1989). This one observation was among 1,730 plovers observed at interior sites. Secondly, a snowy plover that nested at Monterey was observed the following year nesting at a Central Valley site (G. Page pers. comm. 1992). It is expected that more than these two individuals would have been seen if the two populations mixed more fully. In addition, an adult male, banded as a chick in San Diego County, was seen at Owens Lake in May of 1997 and may have been breeding (G. Page and A. Powell pers. comm. 1998). Three snowy plovers banded as chicks on the California coast were observed at interior Oregon breeding sites during the breeding season in 1990 (Stern *et al.* 1991a). However, there was no documentation whether or not these birds nested at these interior sites. Conversely, no breeding plovers or their young banded at Abert Lake, in interior Oregon, Mono Lake in interior California, or at Great Salt Lake, Utah have been observed nesting at any coastal sites (Stern *et al.* 1990a, G. Page pers. comm. 1998). Since 1977, several thousand snowy plovers have been banded on the Pacific coast; the numbers of plovers banded in the interior were: 130 adults and 237 chicks at Mono Lake; 356 adults and 139 chicks at Great Salt Lake; and 166 adults and 204 chicks at Abert Lake (G. Page pers. comm. 1999).

B. LIFE HISTORY AND ECOLOGY

1. Breeding

The Pacific coast population of the western snowy plover breeds primarily on coastal beaches from southern Washington to southern Baja California, Mexico (e.g., coastal beach, Figure 3). This habitat is unstable because of unconsolidated soils, high winds, storms, wave action, and colonization by plants. Sand spits, dune-backed beaches, beaches at creek and river mouths, and salt pans at lagoons and estuaries are the main coastal habitats for nesting (Wilson 1980, Stenzel *et al.* 1981). Less common nesting habitats include bluff-backed beaches, dredged material disposal sites, salt pond levees, dry salt ponds, and river bars (Wilson 1980, Page and Stenzel 1981, Powell *et al.* 1996, Tuttle *et al.* 1997).



Figure 3. Oregon Dunes National Recreational Area (photo by Ruth Pratt, with permission)

a. Population Size and Distribution

Snowy plovers concentrate in suitable habitat, with the number of adults at coastal breeding locations ranging from 1 to 246, depending, in part, on the size of the area (Appendix B). It is estimated that, at most, about 2,000 snowy plovers may breed along the U.S. Pacific coast (Page *et al.* 1995a, Appendix D) and at least a similar number breed on the west coast of Baja California (Palacios *et al.* 1994). The largest number of breeding birds occurs from south San Francisco Bay to southern Baja California (Page and Stenzel 1981, Palacios *et al.* 1994). Population estimates referenced below were based on window surveys, breeding surveys, and data used in the population viability analysis prepared for this recovery plan. The locations of the following parenthetical references to snowy plover breeding and wintering locations in the States of Washington, Oregon, and California are shown in Figures A-1 through A-7 of Appendix A. Information on the numbers of breeding and wintering snowy plovers at these locations is described in Appendix B.

Three breeding areas currently exist in southern Washington: Leadbetter Point, in Willapa Bay (WA-5); Damon Point, in Grays Harbor (WA-2); and Midway Beach (WA-4). During most recent breeding seasons, fewer than 25 plovers and 12 nests

have been found during regular, standardized surveys. In Oregon, nesting birds have been recorded in nine locations (Appendix B). In 1997, snowy plovers nested at seven sites in Oregon: Sutton (OR-8), Siltcoos (OR-10), Tenmile (OR-12), Coos Bay North Spit (OR-13), Bandon (OR-15), New River Spit (OR-15), and Floras Lake (OR-15). An estimated 141 adult plovers were observed at these sites during the breeding season. Ninety-three nests were located, with 52 percent of the nests at two sites (Coos Bay North Spit and New River Spit). In 1995 and 1996, individual nests were also found at two other Oregon sites, Bayocean Spit (OR-3) and Threemile-Umpqua River (OR-11), respectively. Eight geographic areas support over three-quarters of the California coastal breeding population: San Francisco Bay (CA-27 to 47), Monterey Bay (CA-63 to 65), Morro Bay (CA-79 to 81), the Callendar-Mussel Rock Dunes area (CA-83), the Point Sal to Point Conception area (CA-84 to 88), the Oxnard lowland (CA-96 to 99), Santa Rosa Island (CA-93), and San Nicolas Island (CA-100) (Page *et al.* 1991). A survey of breeding snowy plovers along the Pacific coast of Baja California, Mexico in 1991 to 1992 found 1,344 adults, mostly at 4 coastal wetland complexes: Bahia San Quintin; Lagunas Ojo de Liebre and Guerrero Negro; Laguna San Ignacio; and Bahia Magdalena (Palacios *et al.* 1994).

b. Arrival and Courtship

Nesting birds at coastal locations consist of both year-round residents and migrants (Warriner *et al.* 1986). Migrants begin arriving at breeding sites in southern Washington in early March (Widrig 1980) and in central California as early as January, although the main arrival is from early March to late April (Page *et al.* 1995a). Since some individuals nest at multiple locations during the same year, birds may continue arriving through June (Stenzel *et al.* 1994).

Although pair bonds are first observed on the breeding grounds, they are likely to begin while birds are together in wintering flocks. Mated birds from the previous breeding season frequently reunite. Old and new pair bonds may be established prior to territory defense and nest scraping (Warriner *et al.* 1986). In California, pre-nesting bonds and courtship activities are observed as early as mid-February. Similar activities begin by March in Oregon.

During courtship, males defend territories and usually make multiple scrapes. A scrape is a depression in the sand or substrate that a male constructs by leaning forward on his breast and scratching his feet while rotating his body axis (Page *et al.* 1995a). Copulations are associated with scraping behavior (Warriner *et al.* 1986). Females choose which scrape becomes the nest site by laying eggs in one of them.

c. Duration of Breeding Season

Along the west coast of the United States, the nesting season of the snowy plover extends from early March through late September. Generally, the breeding season begins earlier in more southerly latitudes, and may be 2 to 4 weeks earlier in southern California than in Oregon and Washington. Fledging (reaching flying age) of late-season broods may extend into the third week of September throughout the breeding range.

Earliest nests on the California coast occur during the first week of March in some years and by the third week of March in most years (Page *et al.* 1995a). Peak nesting is from mid-April to mid-June (Warriner *et al.* 1986, Powell *et al.* 1997). Hatching lasts from early April through mid-August, with chicks reaching fledging age approximately 1 month after hatching (Powell *et al.* 1997). On the Oregon coast nesting may begin as early as mid-March, but most nests are initiated from mid-April through mid-July (Wilson-Jacobs and Meslow 1984); peak nest initiation occurs from mid-May to early July (Stern *et al.* 1990b). In Oregon, hatching occurs from mid-April through mid-August, with chicks reaching fledging age as early as mid- to late May. Peak hatching occurs from May through July, and most fledging occurs from June through August. On the Washington coast, most adults arrive during late April, with maximum numbers present from mid-May to late June; fledging occurs from late June through August (Washington Department of Fish and Wildlife 1995).

d. Nests and Nest Sites

Nests typically occur in flat, open areas with sandy or saline substrates; vegetation and driftwood are usually sparse or absent (Widrig 1980, Wilson 1980,

Stenzel *et al.* 1981). In southern California, plovers nest in areas with 6 to 18 percent vegetative cover and 1 to 14 percent inorganic cover; vegetation is usually less than 6 centimeters (2.3 inches) tall (Powell *et al.* 1995, 1996). Nests consist of a shallow scrape or depression lined with beach debris (e.g., small pebbles, shell fragments, plant debris, and mud chips); nest lining increases as incubation progresses. Driftwood, kelp, and dune plants provide cover for chicks that crouch near objects to hide from predators. Invertebrates are often found near debris, so driftwood and kelp are also important for harboring plover food sources (Page *et al.* 1995a). Page and Stenzel (1981) found that nests were usually within 100 meters (328 feet) of water, but could be several hundreds of meters away when there was no vegetative barrier between the nest and water. They believed the absence of such a barrier is probably important for newly-hatched chicks to have access to the shore. Powell *et al.* (1995, 1996) also reported nests from southern California were usually located within 100 meters (328 feet) of water, which could be either ocean, lagoon, or river mouth. Although the majority of snowy plovers are site-faithful, returning to the same breeding site in subsequent breeding seasons, some also disperse within and between years (Warriner *et al.* 1986, Stenzel *et al.* 1994). Birds occasionally nest in exactly the same location as the previous year (Warriner *et al.* 1986).

e. Egg Laying, Clutch Size, and Incubation

Along the U.S. Pacific coast, snowy plovers make scrapes in February but never lay eggs that early. Initiation of clutches (i.e., groups of eggs) and egg laying occurs from early March through the third week of July (Wilson 1980, Warriner *et al.* 1986). The approximate periods required for nesting events are: scrape construction (in conjunction with courtship and mating), 3 days to more than a month; egg laying, usually 4 to 5 days; and incubation, 26 to 31 days (mean 27 days) (Warriner *et al.* 1986). The usual clutch size is three eggs (see Figure 4) although, rarely, up to six eggs have been found and two eggs are not unusual (Warriner *et al.* 1986, Page *et al.* 1995a). Both sexes incubate the eggs, with the female tending to incubate during the day and the male at night (Warriner *et al.* 1986). Adult plovers will frequently attempt to lure people and predators from hatching eggs with alarm calls and distraction displays. Occasionally, parents behave similarly when they have incomplete clutches or, less often, clutches that



Figure 4. Snowy plover clutch (photo by Bruce Casler, with permission).

are only partly incubated. More typical, however, is for the incubating adult to run away from the eggs without being seen. Incomplete clutches are those in which all eggs have not been laid. Partly-incubated clutches are those with three eggs having some degree (in days) of incubation.

Snowy plovers renest readily after loss of their eggs (Wilson 1980, Warriner *et al.* 1986). Renesting occurs 2 to 14 days after failure of a clutch and up to five renesting attempts have been observed for a pair (Warriner *et al.* 1986). Double brooding with polyandry (meaning the female successfully hatches more than one brood in a nesting season with different mates) is common in coastal California (Warriner *et al.* 1986) and Oregon (Wilson-Jacobs and Meslow 1984). On the California coast, the breeding season is long enough for some females to triple brood and for some males to double brood (Page *et al.* 1995a). After losing a clutch or brood (i.e., group of chicks) or successfully hatching a nest, plovers may renest at the same site or move up to several hundred kilometers to nest at other sites (Stenzel *et al.* 1994, Powell *et al.* 1997).

f. Clutch Hatching Success

Widely varying clutch hatching success (percent of clutches hatching at least one egg) is reported in the literature. Clutch hatching success ranging from 0 to 90 percent has been recorded for coastal snowy plovers (Widrig 1980, Wilson 1980, Saul 1982, Wilson-Jacobs and Dorsey 1985, Wickham unpubl. data *in* Jacobs 1986, Warriner *et al.* 1986). Low clutch hatching success has been attributed to a variety of factors, including predation, human disturbance, high tides, and inclement weather. In San Diego County, at least one egg hatched in 56 to 76 percent of clutches from 1994 to 1997 (Powell and Collier 1994, Powell *et al.* 1995, 1996, 1997). Observed clutch hatching success ranged from 12.5 to 86.8 percent and averaged 50.6 percent in eight studies of coastal breeding snowy plovers (Page *et al.* 1995a).

g. Brood-rearing

The first chick hatched remains in or near the nest until other eggs (or at least the second egg) hatch. The adult plover, while incubating the eggs, also broods the first chick. The nonincubating adult may also brood the first-born chick a short distance from the nest. If the third egg of a clutch is 24 to 48 hours behind the others in hatching, it may be deserted.

Snowy plover chicks are precocial, leaving the nest within hours after hatching to search for food. They are not able to fly for approximately 4 weeks after hatching; fledging requires 28 to 33 days (mean equals 31 days) (Warriner *et al.* 1986). Broods rarely remain in the nesting area until fledging (Warriner *et al.* 1986, Stern *et al.* 1990b). Plover broods may travel along the beach as far as 6.4 kilometers (4 miles) from their natal area (Casler *et al.* 1993).

Adult plovers do not feed their chicks, but lead them to suitable feeding areas. Adults use distraction displays to lure predators and people away from chicks. Adult plovers signal the chicks to crouch, with calls, as another way to protect them (Page *et al.* 1995a). They may also lead chicks, especially larger ones, away from predators. Most chick mortality occurs within 6 days after hatching (Warriner *et al.* 1986).

Females generally desert mates and broods by the sixth day after hatching and thereafter the chicks are typically accompanied by only the male. While males rear broods, females obtain new mates and initiate new nests (Page *et al.* 1995a).

h. Fledging Success

The fledging success of snowy plovers (percentage of hatched young that reach flying age) varies greatly by location and year. Even snowy plovers nesting on neighboring beach segments may exhibit quite different success in the same year. For example, the percentage of chicks fledged on different beach segments of Monterey Bay in 1997 varied from 11 to 59 percent and averaged 24 percent overall (Page *et al.* 1997). During the prior 13 years, the percentage of young fledged on Monterey Bay beaches averaged 39 percent (Page *et al.* 1997). From the former Moss Landing salt ponds (now known as the Moss Landing Wildlife Area) in Monterey Bay (CA-64 in Appendix B), the fledging rate of chicks ranged from 13.2 percent to 57.1 percent (mean equals 41.4 percent) from 1988 to 1997. In San Diego County, the fledging rate of chicks ranged from 32.6 to 51.4 percent (mean equals 41 percent) from 1994 through 1998 (Powell *et al.* 1997). In Oregon, annual fledging success for 1992 to 1997 for all coastal sites combined, ranged from 30 to 48 percent (mean equals 38 percent) (M. Stern unpubl. data). Like California, there is considerable variation among sites within years. For example, in 1997, the fledging rate ranged from a low of 14 percent at Sutton (OR-8) to a high of 66 percent at South Tenmile (OR-12). There is also variation at individual sites among years. For example, at the Coos Bay North Spit (OR-13), one of the larger nesting areas in coastal Oregon, annual fledging rates for 1993 to 1997 ranged from 32 to 63 percent (mean equals 46 percent).

i. Productivity

The productivity information most useful for this recovery plan is reproductive success (the annual number of young fledged per adult male). For the population viability analysis (Appendix D), males were used in the model because their population parameters can be estimated with greater certainty than for females. In addition, it is reasonable to consider that the availability of males is limiting

reproductive success because they are responsible for post-hatching parental care, and females can lay clutches for more than one male (Warriner *et al.* 1986).

Chicks are considered fledged at 28 days after hatching. Estimates of the number of young fledged per adult male are available for the coast of Oregon, the shoreline of Monterey Bay, California, and the coast of San Diego County, California. Along the Oregon coast, coincident with extensive efforts to protect nests from predators, the average number of young fledged per male and per female annually from 1993 to 1997 has been estimated as 1.04 and 1.30, respectively. Male fledging rates ranged from 0.80 to 1.51 annually and female rates from 0.73 to 2.10 (M. Stern unpubl. data). At Monterey Bay, California, from 1984 to 1991, when little effort was made to protect nests from predators and people, males averaged 0.85 and females 0.86 fledglings annually. After intensive efforts were undertaken to protect nests from predators and people from 1992 to 1997, the number of young fledged per adult averaged 1.11 for males and 1.23 for females (Point Reyes Bird Observatory, unpubl. data). Over the 14 years of study at Monterey Bay, the annual number of young fledged ranged from 0.61 to 1.26 per male and 0.70 to 1.36 per female (Point Reyes Bird Observatory unpubl. data). From 1995 to 1997 in San Diego County, males averaged 0.92 fledged young. From 1994 to 1997 in San Diego County, females averaged 0.87 fledged young. Rates for males ranged from 0.80 to 1.08 fledged young annually, and for females 0.82 to 1.06 fledged young annually (A. Powell and J. Terp unpubl. data). From 1995 to 1997, nesting snowy plovers in San Diego County likely benefitted from predator management efforts targeted at California least terns (A. Powell pers. comm. 1998). Male reproductive rates were used in the snowy plover population viability analysis as explained in Appendix D.

j. Survival

Annual survival rates for adult and juvenile snowy plovers have been calculated from studies of color banded birds from the coast of Oregon (M. Stern unpubl. data), the shoreline of Monterey Bay, California (Point Reyes Bird Observatory unpublished data), and the coast of San Diego County, California (A. Powell and J. Terp unpublished data) using the program SURGE (Lebreton *et al.* 1992, Cooch *et al.* 1996). Annual juvenile survival rates for fledged young averaged 51 percent

from the Oregon coast, 45 percent from Monterey Bay, and 45 percent from the San Diego coast. Annual survival rates for adult females averaged 75 percent from the Oregon coast, 69 percent from Monterey Bay, and 72 percent from the San Diego coast. Male survival rates were 75 percent for the Oregon coast, 75 percent for Monterey Bay, and 71 percent for San Diego County. Differences between males and females were only significant for the Monterey Bay area. Adult survival rates for San Diego County were not significantly different from the other areas. Appendix D explains how these survival rates were incorporated into the population viability analysis. At the Great Salt Lake, Utah, Paton (1994) estimated annual survival rates of snowy plovers from 58 to 88 percent, depending on year, with no significant difference between the sexes.

2. Feeding Habitat and Habits

Snowy plovers are primarily visual foragers, using the run-stop-peck method of feeding typical of *Charadrius* species. They forage on invertebrates in the wet sand and amongst surf-cast kelp within the intertidal zone, in dry, sandy areas above the high tide, on salt pans, on spoil sites, and along the edges of salt marshes, salt ponds, and lagoons. They sometimes probe for prey in the sand and pick insects from low-growing plants. At the Bolsa Chica wetlands in California, snowy plovers have been observed pecking small, flying insects from mid-air and shaking one foot in very shallow water to agitate potential prey (Fancher *et al.* 1998). Snowy plover food consists of immature and adult forms of marine and terrestrial invertebrates. Little quantitative information is available on food habits. In San Diego, invertebrates found in snowy plover feces during the breeding season included rove beetles (Staphylinidae), long-legged flies (Dolichopodidae), shore flies (Ephydriidae), water bugs (Saldidae), hymenopterans (Braconidae), and unidentified insect larvae (Tucker and Powell 1999). During the breeding season, Jacobs (1986) observed adult snowy plovers feeding on sand hoppers (Orchestoidea) and small fish on the Oregon coast. Other food items reported for coastal snowy plovers include mole crabs (*Emerita analoga*), crabs (*Pachygrapsus crassipes*), polychaetes (*Neridae*, *Lumbrineris zonata*, *Polydora socialis*, *Scoloplos acmaceps*), amphipods (*Corophium* spp., *Ampithoe* spp., *Allorchestes angustus*), tanadacians (*Leptochelia dubia*), flies (Ephydriidae), beetles (Carabidae, Buprestidae, Tenebrionidae), clams (*Transenella* sp.), and

ostracods (Page *et al.* 1995a). In San Francisco Bay salt evaporation ponds, the following prey have been recorded: flies (*Ephydra cinerea*), beetles (*Tanarthrus occidentalis*, *Bembidion* sp.), moths (*Perizoma custodiata*), and lepidopteran caterpillars (Feeney and Maffei 1991).

3. Migration

While some snowy plovers remain in their coastal breeding areas year-round, others migrate south or north for winter (Warriner *et al.* 1986, Page *et al.* 1995a, Powell *et al.* 1997). On Monterey Bay in California, 41 percent of nesting males and 24 percent of the females were consistent year-round residents (Warriner *et al.* 1986). At Camp Pendleton in San Diego County, California, about 30 percent of nesting birds stayed during winter (Powell *et al.* 1995, 1996, 1997). The migrants vacate California coastal nesting areas primarily from late June to late October (Page *et al.* 1995a). There is evidence of a late-summer (August/September) influx of snowy plovers into Washington; it is suspected that these wandering birds are migrants (S. Richardson pers. comm. 1998).

Most plovers that nest inland migrate to the coast for the winter (Page *et al.* 1986, 1995b). Those from the Central Valley of California and the western Great Basin migrate to the California or Baja California coasts, and those from the eastern Great Basin (Great Salt Lake) migrate to Mexico (Page *et al.* 1995b). The departure from inland nesting areas begins by early July and is completed, except for stragglers, by mid-October (Page *et al.* 1995a).

Thus, the flocks of nonbreeding birds that begin forming along the U.S. Pacific coast in early July are a mixture of adult and hatching-year birds from both coastal and interior nesting areas. During migration and winter, these flocks range in size from a few individuals to up to 300 birds (Appendix B).

4. Wintering

a. Distribution and Abundance

In western North America, the snowy plover winters (here defined as November 1 to February 28/29) mainly in coastal areas from southern Washington to Central America (Page *et al.* 1995a). Both coastal and interior populations use coastal locations in winter. Small numbers of plovers occur at two locations on the Washington coast, the northernmost being Midway Beach (WA-4) in Pacific County (S. Richardson pers. comm. 1998). Fewer than 100 plovers winter at 9 locations on the Oregon coast (Appendix B), probably as many as 2,500 along the mainland California coast, and hundreds more at each of San Francisco Bay and the Channel Islands (Appendix B, Page *et al.* 1986). The majority of wintering plovers on the California coast are found from Bodega Bay, Sonoma County, southward (Page *et al.* 1986). Inland, a few hundred birds also winter at agricultural waste water ponds in the San Joaquin Valley and at desert saline lakes, particularly the Salton Sea in California (Shuford *et al.* 1995).

Nesting birds from the Oregon coast have wintered as far south as Monterey Bay, California; those from Monterey Bay in central California have wintered north to Bandon, Oregon, and south to Laguna Ojo de Liebre, Baja California, Mexico (Page *et al.* 1995a); and those from San Diego in southern California have wintered north to Vandenberg Air Force Base in Santa Barbara County and south to Laguna Ojo de Liebre, Baja California, Mexico (Powell *et al.* 1995, 1996, 1997).

In winter, snowy plovers are found on many of the beaches used for nesting and some beaches where they do not nest (Appendix B). They also occur in man-made salt ponds and on estuarine sand and mud flats. In California, the majority of wintering plovers concentrate on sand spits and dune-backed beaches. Some also occur on urban and bluff-backed beaches, which are rarely used for nesting (Page *et al.* 1986). Pocket beaches at the mouths of creeks and rivers on otherwise rocky shorelines are used by wintering plovers south, but not north, of San Mateo County, California. In Washington, the main wintering location is

Leadbetter Point, Willapa Bay (Washington Department of Fish and Wildlife 1995).

b. Site Fidelity

Snowy plovers that breed on the coast and inland are very site faithful in winter (Point Reyes Bird Observatory unpublished data). For example, after 166 adults and 204 chicks were banded at Lake Abert, Oregon during summer, many were subsequently found along the California and Baja California, Mexico coasts. Of those for which a wintering location was identified, 67 percent of the adult males, 73 percent of the adult females, and 60 percent of the birds banded as chicks (immatures) were found at the same winter location in at least 2 consecutive years; and 33 percent of the males, 32 percent of the females, and 35 percent of the immatures for at least 3 years (Page *et al.* 1995*b*).

c. Behavior

Snowy plovers are typically gregarious in winter. Although some individuals defend territories on beaches, most usually roost in loose flocks; frequently plovers are also observed foraging in loose flocks (Page *et al.* 1995*a*). Roosting plovers usually sit in small depressions in the sand, or in the lee of kelp, other debris, or small dunes (Page *et al.* 1995*a*). Sitting behind debris or in depressions provides some shelter from the wind and probably makes the birds more difficult for predators to detect. When roosting snowy plovers are disturbed, they frequently run a few meters to a new spot where they sometimes displace other individuals. Alternatively, the whole flock may fly to a new location.

C. POPULATION STATUS AND TRENDS

1. Historical Trends

Historical records indicate that nesting western snowy plovers were once more widely distributed and abundant in coastal Washington, Oregon, and California than they are currently. In Washington, snowy plovers formerly nested at five coastal locations (Washington Department of Fish and Wildlife 1995). Three

sites are currently active, representing a minimum 40 percent decline in Washington breeding sites. In Oregon, snowy plovers historically nested at 29 locations on the coast (C. Bruce pers. comm. 1991). Currently, there are only nine nesting locations, representing a 69 percent decline in active breeding areas. In California, there has also been a significant decline in breeding locations, especially in southern California.

a. Washington Coast

Records for snowy plovers in Washington span a full century. Most early accounts described plover abundance at specific sites with terms such as “several” or “small numbers.” Although similar descriptors could still be applied today, current field efforts are more thorough than in the past. In addition, significant habitat losses have occurred, primarily through erosion and invasion of introduced beachgrass, and some sites no longer support nesting plovers. For these reasons, a decline in the Washington population is believed to have occurred, but it is difficult to quantify.

Copalis Spit (WA-1) held 6 to 12 snowy plover pairs in the late 1950's or early 1960's, according to biologist Gordon Alcorn (cited in Washington Department of Fish and Wildlife 1995). No other information on breeding at Copalis Spit is available. Suitable habitat was judged capable of supporting four pairs in 1984 (Ralph Widrig, cited in Washington Department of Fish and Wildlife 1995). Periodic surveys since 1983 have revealed just a single plover (Washington Department of Fish and Wildlife unpubl. data).

Damon Point and Oyhut Wildlife Area (WA-2) lack snowy plover records prior to 1971, but this is due to limited visitation rather than plover absence. Between 1971 and 1983, birders reported up to six plovers during infrequent visits to Damon Point (Washington Department of Fish and Wildlife 1995). Plover research in 1985 and 1986 revealed up to 20 plovers and 8 nests at Damon Point (Anthony 1987), but no more than 5 nests have been found in subsequent years (Washington Department of Fish and Wildlife 1995, unpublished data). Intensive surveys in 1997 and 1998 revealed five or fewer plovers and no more than two nests each year (Washington Department of Fish and Wildlife unpublished data).

Westport Spit (WA-3) held low numbers of snowy plovers from before 1915 until at least 1968, and scientific collecting was concentrated there through 1934 (Washington Department of Fish and Wildlife 1995). A single nest, poorly documented, was reported in 1983 (Washington Department of Fish and Wildlife unpublished data). No other quantitative information on abundance or nesting is available for this site, which has now eroded significantly. Regular visits between 1994 and 1998 revealed no plovers (Washington Department of Fish and Wildlife, unpublished data).

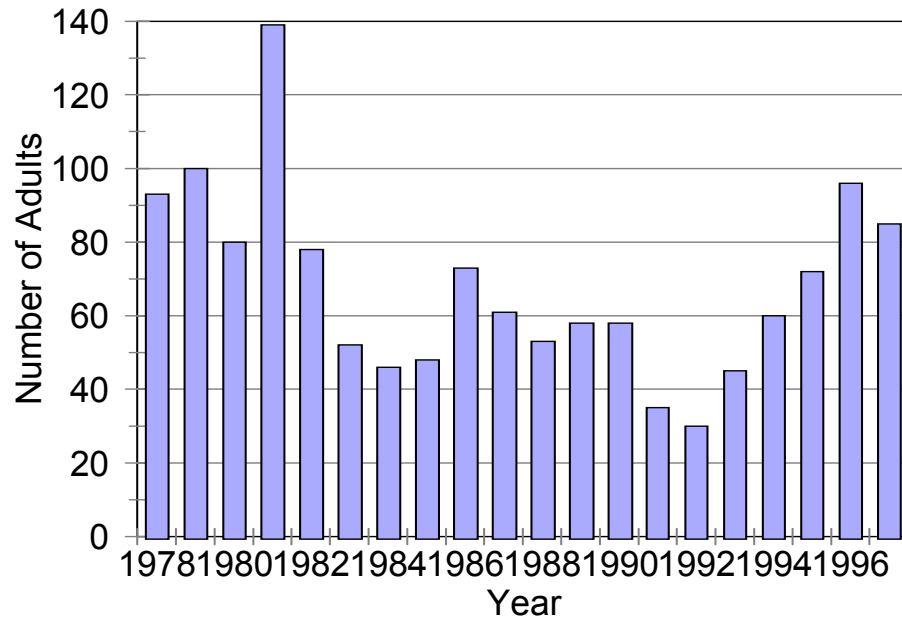
Midway Beach (WA-4) and Cape Shoalwater once contained several hundred acres of suitable snowy plover habitat, but the area lacks historical records of these birds except for specimens collected in 1914 and 1960 and labeled “Tokeland” (Washington Department of Fish and Wildlife 1995). Regular surveys between 1994 and 1998 suggested intermittent plover use, with an estimated eight plovers and six nests in 1998 (Richardson *et al.* in prep.).

Leadbetter Point (WA-5) was rarely visited by plover observers prior to 1964. In the 1960's and 1970's, birders reported up to 35 plovers. In 1967, the sighting of two chicks confirmed nesting in Washington (Washington Department of Fish and Wildlife 1995). Up to 24 plovers and between 7 and 11 nests were estimated to be present in 1978, 1979, and 1981 (Widrig 1980, 1981). Up to 23 plovers and 7 nests were found from 1985 to 1989 (Willapa National Wildlife Refuge unpublished data), and similar numbers occurred from 1995 to 1997 (Williamson 1995, 1996, 1997). In recent years, Gunpowder Sands, a dynamic shoal just north of Leadbetter Point, has supported up to 11 plovers and 2 nests between May and July (Williamson 1995, 1996, 1997).

b. Oregon Coast

In Oregon, annual surveys of snowy plovers, including both adults and young of the year, began in 1978, with counts ranging from a high of 139 to a low of 30 (Table 1). From 1978 to 1981, the mean number of plovers observed annually along the Oregon coast was 104 at 12 sites. At 10 of these sites, plovers were observed in all 4 years, while at the remaining 2 sites, plovers were recorded in 3 of 4 years. The number of plovers declined through the 1980's, and reached a low

Table 1. Histogram of the number of adult snowy plovers on window surveys of the Oregon coast during the breeding season. Window surveys estimate the number of birds seen during 1-day censuses in May to June.



Year	Number	Year	Number
1978	93	1988	53
1979	100	1989	58
1980	80	1990	58
1981	139	1991	35
1982	78	1992	30
1983	52	1993	45
1984	46	1994	60
1985	48	1995	72
1986	73	1996	96
1987	61	1997	85

from 1991 to 1993 with a mean of 33 individuals recorded annually. From 1994 to 1997, plover numbers increased, with a mean of 78 plovers observed at 7 sites. The increase in recent years is related to intensive management, including the use of exclosures to reduce predation, restoration of breeding habitat by removing European beachgrass, increased presence of law enforcement personnel, additional and improved signs, additional symbolic fencing (consisting of one or two strands of light-weight string or cable tied between posts to delineate areas where pedestrians and vehicles should not enter), and increased efforts on public information and education. Along the Oregon coast where intensive management has taken place, the number of snowy plovers have decreased over 25 percent since 1978 to 1981, and the number of active sites have decreased from 12 to 7. However, without intensive management, it is likely that current plover numbers would be considerably lower.

Since 1993, the population on the Oregon coast has been intensively monitored, with many of the adults and chicks being uniquely color-banded. The presence of marked birds has allowed for the development of two other means of estimating the population (Table 2). The number of snowy plovers, as indicated by all three indices in Table 2, has increased between 1993 and 1997. The increasing trend for all three indices remains consistent throughout the measurement period.

c. California Coast

i. Coastwide Perspective

The first quantitative data on the abundance of snowy plovers along the California coast came from window surveys conducted during the 1977 to 1980 breeding seasons by Point Reyes Bird Observatory (Page and Stenzel 1981, Table 3). Window surveys are a one-time pass of a surveyor or team of surveyors through potential snowy plover nesting habitat during May or June. The surveyor counts all adult snowy plovers in the habitat and separates the adults into males and females when possible. An estimated 1,593 adult snowy plovers were seen (and extrapolated for one location not completely covered) on the pioneer surveys (Table 3). The surveys suggested that the snowy plover had disappeared from

significant parts of its coastal California breeding range by 1980. It no longer bred along the beach at Mission Bay or at Buena Vista Lagoon in San Diego County. In Orange County, the only remaining breeding location was the Bolsa Chica wetlands; historically, the snowy plover was known to breed along the beach from Upper Newport Bay to Anaheim Bay. It was absent from Los Angeles County where it formerly nested along the shores of Santa Monica Bay. In Ventura County, it had ceased breeding on Ventura Beach (San Buenaventura Beach), and in Santa Barbara County on Carpinteria, Santa Barbara (East Beach), and Goleta Beaches. Nesting no longer occurred along the northernmost portion of Monterey Bay in Santa Cruz County or on Doran Beach at Bodega Harbor in Sonoma County.

Subsequent coast-wide surveys by Point Reyes Bird Observatory in 1989 and 1991 indicated a further decline in numbers of breeding adult snowy plovers during the decade after the 1977 to 1980 survey. Along the mainland coast, including the shores of the Channel Islands, the decline of the snowy plover was 4.9 percent, and in San Francisco Bay about 40 percent (Table 3). The most recent coastwide survey, during the summer of 1995, was accomplished through

Table 2. Comparison of population estimates of adult western snowy plovers on the Oregon coast during the breeding season (1993 to 1997) based on three different measures of abundance. Data for B and C estimates provided by M. Stern (pers. comm. 1998).

Year	Estimates		
	A	B	C
1993	45	55 to 61	72
1994	52	67	83
1995	67	94	120
1996	87	110 to 113	134 to 137
1997	85	106 to 110	141

A = Window census.

B = Estimated number of breeding adults. This number is lower than those in column C because it is an estimate of the number of individual birds thought to be breeding birds.

C = Total number of individual adults present during breeding season.

Table 3. Number of adult snowy plovers during breeding season window surveys of the California coast.

Location	1977/80	1989	1991	1995
Del Norte County	11	8	3	0
Humboldt County	54	32	30	19
Mendocino County	15	2	0	-
Sonoma County	0	10	9	2
Marin County	40	24	25	8
San Mateo County	4	8	1	2
Northern Santa Cruz County	25	19	22	33
Monterey Bay	146	146	121	125
Point Sur	3	4	-	-
Morro Bay Area	80	126	87	85
Pismo Beach/Santa Maria River	45	123	246	124
Vandenberg Air Force Base	119	115	242	213
Jalama Beach	0	1	1	0
Oxnard Lowland	136	175	105	69
Channel Islands	(288) ¹	217	200	196
Orange County	19	21	6	9
Northern San Diego County	160	72	48	49
San Diego Bay	60	36	31	33
Tijuana Estuary	37	21	4	10
Subtotal	1242	1160	1181	977
South San Francisco Bay	351	216	(203) ²	-
Total	1593	1376	1384	-

¹ 260 adults during the survey; 28 additional adults extrapolated for unsurveyed portions of Santa Rosa Island.

² 176 seen during the survey; 27 additional birds extrapolated for unsurveyed areas.

the collaboration of researchers studying snowy plovers along the California coast. This survey suggested a further 17.3 percent decline in the number of breeders along the outer coast, making a 21 percent decline since the initial surveys of 1977 to 1980. Because San Francisco Bay was not surveyed in 1995, it is not known whether numbers there have changed from 1991 levels. Between the 1977 to 1980 surveys and the 1995 survey, the snowy plover seems to have ceased nesting at Los Penasquitos, San Elijo, and Agua Hedionda Lagoons in northern San Diego County (A. Powell pers. comm. 1998); Año Nuevo State Beach and Pescadero State Beach in San Mateo County; Bolinas Lagoon in Marin County; MacKerricher Beach in Mendocino County; the south and north spits of Humboldt Bay and Big Lagoon in Humboldt County; and the Lake Talawa region of Del Norte County (Point Reyes Bird Observatory, unpublished data).

Information on numbers of snowy plovers along the coast of California since 1995 is available only for some sites. For those sites where nesting plovers are monitored and most of the birds are color banded, estimates of the total number of nesting birds have been made (Table 4). Breeding season window surveys are also available from some sites (Table 4). However, estimates from both window surveys and total nesting birds are not available for any site from 1995 to 1997.

ii. Regional Perspective

Mendocino, Humboldt, and Del Norte Counties - Numbers of breeders have declined in this northern California region since the initial Point Reyes Bird Observatory survey in 1977. In 1977, 80 adults were tallied for the region compared to 42 in 1989, 33 in 1991, and 19 in 1995. The Point Reyes Bird Observatory also conducted a survey of Humboldt County and Del Norte County beaches during the summer of 1996 (regular nesting had ceased in Mendocino County by this date) and tallied 15 adults. In 1996, snowy plovers were documented breeding on the gravel bars of the Eel River, Humboldt County, for the first time. R. LeValley (pers. comm. 1997) estimated that as many as 30 snowy plovers nested on these gravel bars in 1997. Even if some plovers had shifted from the beaches to the bars between 1977 and 1996, the total for the beaches and bars ($15 + 30 = 45$) is still a reduction from the 80 plovers tallied in 1977.

Table 4. Number of adult snowy plovers at selected California nesting sites, 1995 to 1997.

Location	1995	1996	1997	Data Type
Humboldt County Beaches	19	15	-	Window Survey
Point Reyes, Marin County	12	10-11	25	Total Breeders
North Santa Cruz County	27-30	22-26	22-23	Total Breeders
Monterey Bay	186-198	210-217	228-231	Total Breeders
Atascadero Beach	38	28	23	Window Survey
Morro Bay Spit	34	40	39	Window Survey
Vandenberg Air Force Base	213	230	258	Window Survey
Ormond Beach	20	19	34	Window Survey
Mugu Naval Weapons Station	40	49	26	Window Survey
Santa Rosa Island	71	78	79	Window Survey
San Miguel Island	9	3	5	Window Survey
San Nicolas Island	116	104	91	Window Survey
Bolsa Chica	8	22	21	Window Survey
San Diego County	255	272	282	Total Breeders
Total Number of snowy plovers	1048-1063	1102-1114	1133-1137	

San Francisco Bay - As indicated in Table 3, numbers in San Francisco Bay declined markedly between the initial survey in 1978 and follow-up surveys in 1989 and 1991. This region should be covered again to determine the snowy plover's current status.

Monterey, Santa Cruz, San Mateo, San Francisco, Marin, and Sonoma Counties - Along this segment of coastline, numbers of adults during window surveys in 1977 to 1978, 1989, 1991, and 1995 were: 215, 207, 178, and 170, respectively. Point Sur is excluded from these estimates because of a lack of data in 1991 and 1995. Thus, a decline for the region is indicated. However, the numbers of adults breeding on the beaches and salt ponds of Monterey Bay, and the beaches of northern Santa Cruz County, increased nearly 40 percent between 1993 and 1997 after management actions were undertaken to increase nesting success (Point Reyes Bird Observatory, unpublished data)

Ventura, Santa Barbara, and San Luis Obispo Counties - There is no clear evidence of an overall decline in the number of breeding snowy plovers for this region from 1978/1980 to the present. Numbers of adults during 1978, 1989, 1991, 1995, and 1998 window surveys were: 668, 757, 881, 687, and 570, respectively. While numbers for the region may not have changed overall, there have been definite changes at specific locations (Table 5). Most notable is the decline in numbers on San Miguel Island from 1978 /1980 to 1997, and the sudden increase in numbers at Vandenberg Air Force Base between 1989 and 1991, followed by the sudden decline from 1997 to 1998 (Table 5).

Table 5. Breeding season surveys of snowy plover adults at selected sites along the coast of San Luis Obispo, Santa Barbara, and Ventura Counties.

Location	Year						
	1978-80	1989	1991	1995	1996	1997	1998
Atascadero Beach	0	17	2	38	28	23	26
Morro Bay Spit	80	94	69	34	40	39	55
Vandenberg Air Force Base	119	115	242	213	230	238	130
Ormond Beach	25	24	34	20	19	34	19
Mugu Naval Weapons Station	82	81	59	40	49	26	47
Santa Rosa Island	84	91	103	71	78	79	76
San Miguel Island	133	36	19	9	3	5	1
San Nicolas Island	71	90	78	116	104	91	90
Total	594	548	606	541	551	535	444

San Diego, Orange, and Los Angeles Counties - Numbers have declined during window surveys from the period 1978 to 1995. From the 276 adults tallied during the 1978 Point Reyes Bird Observatory survey, numbers declined to 150 adults during the 1989 survey and 89 on the 1991 survey. A window survey by Abby Powell, U.S. Geological Survey/Biological Resources Division, and her colleagues produced 101 adults during the summer of 1995. The 1995 estimate represented only 37 percent of the adults from the 1978 survey. Since 1995, the total number of plovers nesting in San Diego County during the course of a summer has been increasing (Table 4). Because birds move around, the number of banded birds tallied over a whole summer is greater than the number that could be found on any particular day of a window survey.

2. Current Breeding Distribution

The current Pacific coast breeding range of the snowy plover extends from Damon Point, Washington, to Bahia Magdalena, Baja California, Mexico. The population

is sparse in Washington, Oregon, and northern California. At present, fewer than 40 adults are believed to be nesting in Washington, slightly more than 100 in coastal Oregon, and fewer than 100 in California, north of the Golden Gate. When last surveyed in 1991, just over 200 adults were counted during the breeding season in San Francisco Bay. Almost all were in salt evaporation ponds in south San Francisco Bay. To the south of San Francisco Bay, the first large concentration of snowy plovers is found along the shoreline of Monterey Bay where currently 200 to 250 adults breed. Other large concentrations of nesting snowy plovers occur south of Monterey Bay. Breeding season counts of nesting snowy plovers during 1991, 1995, and 1998 ranged from 85 to 93 adults in the Morro Bay area, from 103 to 246 adults between Pismo Beach and Point Sal, from 130 to 240 on Vandenberg Air Force Base, and from 69 to 105 in the Oxnard Lowland. During the 1990's, 70 to 100 adults were consistently tallied during breeding season counts of Santa Rosa Island. Similar numbers are found on San Nicolas Island. South of Ventura County in the United States, nesting snowy plovers are confined primarily to Bolsa Chica in Orange County, where there are approximately 30 breeding adults, and to the coast of San Diego County with an estimated 282 nesting adults in 1997. Along the coast of Baja California, Mexico, most nesting snowy plovers are associated with the largest wetlands, especially Bahia San Quintin, Laguna Ojo de Liebre, and Bahia Magdalena. Probably as many snowy plovers nest along the west coast of Baja California, Mexico as along the U.S. Pacific coast (Palacios et al. 1994).

3. Habitat Carrying Capacity

There is no quantitative information on carrying capacity of beaches for snowy plovers. The structure, width, vegetation, and level of human use of beaches is quite variable, complicating such a measurement. With extensive management of approximately 55 hectares (138 acres) of mostly dried ponds in the Moss Landing Wildlife Area, Point Reyes Bird Observatory biologist Doug George has been able to document 25 active nests, 3 pairs within 5 days of initiating nests, and 10 broods simultaneously. Thus, a *peak* of 76 nesting adults were accommodated simultaneously by 55 hectares (138 acres) of playa, or 1.4 hectares (3.6 acres) per functional pair (some of the broods were only being cared for by males) (Point Reyes Bird Observatory unpublished data). If calculated over the approximate 4-

year period since management at the Moss Landing Wildlife Area commenced, the number of nesting adults would be smaller.

The numbers of nesting snowy plovers at the Moss Landing Wildlife Area cannot be applied to beach areas because of the physical differences between salt pond and beach habitats and because beach habitats are typically subject to much more human disturbance. Also, since 1995, Point Reyes Bird Observatory staff have conducted intensive management specifically for snowy plovers at the Moss Landing Wildlife Area. These measures include predator control, removal of excessive vegetation, and operation of water control structures to maintain desired water levels. These numbers also cannot be applied to some other salt ponds (e.g., San Francisco Bay) because of the need to flood larger areas within the salt pond system to keep sufficient areas from being vegetated while maintaining sufficient, suitable nesting habitat (e.g., salt pans) for snowy plovers from year to year.

D. REASONS FOR DECLINE AND CONTINUING THREATS

Overall, western snowy plover numbers have declined on the U.S. Pacific coast over the past century (see Population Status and Trends section). Habitat degradation caused by human disturbance, urban development, introduced beachgrass (*Ammophila* spp.), and expanding predator populations have resulted in a decline in active nesting areas and in the size of the breeding and wintering populations. Natural factors, such as inclement weather, have also affected the quality and quantity of snowy plover habitat (U.S. Fish and Wildlife Service 1993a). The reasons for decline and degree of threats vary by geographic location. The following discussion is organized according to the five listing criteria under section 4(a)(1) of the Endangered Species Act.

1. The Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

a. Shoreline Stabilization and Development

The wide, flat, sparsely-vegetated beach strands preferred by snowy plovers are an unstable habitat, subject to the dynamic processes of accretion and erosion and

dependent on natural forces for replenishment and renewal. These habitats are highly susceptible to degradation by construction of seawalls, breakwaters, jetties, piers, homes, hotels, parking lots, access roads, trails, bike paths, day-use parks, marinas, ferry terminals, recreational facilities, and support services that may cause direct and indirect losses of breeding and wintering habitat for the snowy plover.

Beach stabilization efforts may interfere with coastal dune formation and cause beach erosion and loss of snowy plover nesting and wintering habitat. Shoreline stabilization features such as jetties and groynes may cause significant habitat degradation by robbing sand from the downdrift shoreline (U.S. Fish and Wildlife Service 1996a). However, jetties can also redirect sand deposition, causing an increase in available habitat. Construction of homes, resorts, and parking lots on coastal sand dunes constitutes irrevocable loss of habitat for snowy plovers. Construction of these and other facilities adjacent to sand dunes also results in loss of breeding and wintering habitat by increasing human disturbance to levels where beaches are no longer suitable for snowy plovers (see Figure 5). Urban development has permanently eliminated valuable nesting habitat on beaches in southern Washington (Brittall *et al.* 1976), Oregon (Oregon Department of Fish



Figure 5. New housing development next to beach at Monterey Bay, California (photo by Peter Baye, with permission).

and Wildlife 1994), and California (Page and Stenzel 1981). In addition to causing direct loss of habitat, there are additional potential adverse impacts to snowy plovers from urban development. When urban areas interface with natural habitat areas, the habitat value to native species may be diminished by increased levels of illumination at night (e.g., building and parking lot lights); increased sound and vibration levels; and pollution drift (e.g., pesticides) (Kelly and Rotenberry 1996/1997). Also, construction of residential development in or near snowy plover habitat attracts predators, including domestic cats.

b. Resource Extraction

i. Sand Removal and Beach Nourishment

Sand is mined in coastal areas such as Monterey Bay. Mining sand from the coastal mid-dunes and surf zone can cause erosion and loss of snowy plover breeding and wintering habitat. Sand removal by heavy machinery can disturb incubating plovers, destroy their nests or chicks, and result in the loss of invertebrates and natural wave-cast kelp and other debris that plovers use for foraging. Mining of surface sand from the 1930's through the 1970's at Spanish Bay in Monterey County degraded a network of dunes by lowering the surface elevations, removing sand to granite bedrock in many locations, and creating impervious surfaces that supported little to no native vegetation (Guinon 1988).

Beach nourishment with sand can be beneficial for the snowy plover if it results in an increase in habitat. However, unless beach nourishment projects are properly designed and use appropriately-sized sediments, they can result in changes to beach slope from redeposit of sediments by storm waves, and result in the loss of snowy plover breeding and wintering habitat. For example, if an inappropriate size class of sand (e.g., coarser-grained sand) and range of minerals are introduced that are different from the current composition of native sand on a beach, it can alter dune slope (making it steeper or narrower), sand mobility and sand color, decrease the abundance of beach invertebrates, and facilitate establishment of invasive exotic plants that may have a competitive advantage over native plants. Feeney and Maffei (1991) investigated the color hues of the ground surface within San Francisco Bay salt ponds used as snowy plover nesting habitat. Predominant

soils were silty clay with varying amounts of humus, salt crystals, and shell fragments. They found a strong similarity between the color of the substrate in habitat preferred by snowy plovers and the color of plover mantles. Also, heavy equipment associated with beach nourishment activities may destroy nests or chicks, or disturb breeding and wintering plovers.

ii. Dredging and Disposal of Dredged Materials

Dredging is detrimental to snowy plovers when it eliminates habitat or alters natural patterns of beach erosion and deposition that maintain habitat. Disturbances associated with dredging, such as placement of pipes, disposal of dredged materials, or noise, also may negatively affect breeding and wintering plovers. Dredging is detrimental when it promotes water-oriented developments that increase recreational access to plover habitat (e.g., marinas, boat ramps, or other facilities to support water-based recreation). Dredged materials may provide important nesting habitat for plovers such as those at Coos Bay, Oregon (Wilson-Jacobs and Dorsey 1985). Snowy plovers have also been observed using dredged material during the winter; however, these areas are not used nearly as often as the adjacent ocean beach (E.Y. Zielinski and R.W. Williams *in litt.* 1999).

iii. Driftwood Removal

Driftwood can be an important component of snowy plover breeding and wintering habitat. Plovers often nest beside driftwood, so its removal may reduce the number of suitable nest sites. Driftwood contributes to dune-building and adds organic matter to the sand as it decays (Washington Department of Fish and Wildlife 1995). Additionally, driftwood provides snowy plovers with year-round protection from wind and blowing sand.

Driftwood removal can negatively affect snowy plover habitat. Driftwood removed for firewood or decorative items can result in destruction of nests and newly-hatched chicks that frequently crouch by driftwood to hide from predators and people. Removal of driftwood has been documented as a source of nest destruction at Vandenberg Air Force Base where two nests were crushed beneath driftwood dragged to beach fire sites (Persons 1994). Also, driftwood beach

structures built by visitors are used by avian predators of snowy plover chicks such as loggerhead shrikes (*Lanius ludovicianus*) and American kestrels (*Falco sparverius*), and predators of adults such as merlins (*Falco columbarius*) and peregrine falcons (*Falco peregrinus*).

Although driftwood is an important component of snowy plover habitat, too much driftwood on a beach, which may occur after frequent and prolonged storm events, can be detrimental if there is not sufficient open habitat to induce the birds to nest.

iv. Beach Fires and Camping

Beach fires and camping may be harmful to nesting snowy plovers when valuable driftwood is destroyed, as described above. Nighttime collecting of wood increases the risk of stepping on nests and chicks, which are difficult to see even during daylight hours. Fires near a snowy plover nest could cause nest abandonment due to disturbance from human activities, light, and smoke. Fires have the potential to attract large groups of people and result in an increase of garbage, which attracts scavengers such as gulls (*Larus* spp.) and predators such as coyotes (*Canis latrans*), American crows (*Corvus brachyrhynchos*), and common ravens (*Corvus corax*). Also, after fires are abandoned, predators such as coyotes may be attracted into the area by odors lingering from the fire, particularly if it was used for cooking.

v. Water Course Diversion, Impoundment, or Stabilization

Water diversion and impoundment of creeks and rivers may negatively affect snowy plover habitat by reducing sand delivery to beaches and degrading water quality. Water diversions are a major threat to snowy plovers when they impair hydrologic processes (such as migration of creek and river mouths) that maintain open habitat at river and creek mouths by retarding the spread of introduced beachgrass (*Ammophila* spp.) and other vegetation. Water diversion, impoundment, or stabilization activities could include construction of dams and irrigation, flood control, and municipal water development projects.

vi. Operation of Salt Ponds

Salt ponds of San Francisco Bay and San Diego Bay, which are filled and drained as part of the salt production process, provide breeding and wintering habitat for snowy plovers. Dry salt ponds and unvegetated salt pond levees are used as plover nesting habitat. Ponds with shallow water provide important foraging habitat for plovers. Nesting plovers can be attracted to an area when ponds are drained during the breeding season, but flooding can then destroy the nests when the ponds are refilled. Also, human disturbance resulting from maintenance activities associated with the operation of commercial salt ponds (i.e., levee reconstruction and maintenance of facilities) can result in the loss of snowy plovers and alteration or disturbance of their habitat. If conducted during the snowy plover breeding season, reconstruction of salt pond levees could destroy snowy plover nests. Maintenance activities that are conducted by vehicles, on foot, or through the use of dredging equipment could result in direct mortality or harassment of snowy plovers (See Dredging, Pedestrian, and Motorized Vehicle sections).

c. Encroachment of Introduced Beachgrass and Other Nonnative Vegetation

One of the most significant causes of habitat loss for coastal breeding snowy plovers has been encroachment of introduced European beachgrass (*Ammophila arenaria*) and American beachgrass (*Ammophila breviligulata*). Foredunes dominated by introduced beachgrass have replaced the original low, rounded, open mounds formed by the native American dunegrass (*Leymus mollis*) and other beach plants. Native dune plants do not bind sand like *Ammophila*, and thus allow for sand movement and regenerating open expanses of sand. However, *Ammophila* forms a dense cover that excludes many native taxa. On beaches dominated by this invasive grass, species richness of vegetation is halved, in comparison with foredunes dominated by native dune grass (Barbour and Major 1990). Similarly, American beachgrass greatly depresses the diversity of native dune plant species (Seabloom and Wiedemann 1994).

European beachgrass was introduced to the west coast around 1898 to stabilize dunes (Wiedemann 1987). Since then, it has spread up and down the coast and

now is found from British Columbia to southern California (Ventura County). This invasive species is a rhizomatous grass that sprouts from root segments, with a natural ability to spread rapidly. Its most vigorous growth occurs in areas of wind-blown sand, primarily just above the high-tide line, and it thrives on burial under shifting sand. In 1988, European beachgrass was considered a major dune plant at about 50 percent of snowy plover breeding sites in California and all of those in Oregon and Washington (J.P. Myers, National Audubon Society, *in litt.* 1988).

American beachgrass is native to the East coast and Great Lakes region of North America. The densest populations of American beachgrass on the Pacific coast are currently located between the mouth of the Columbia River and Westport, Washington. It is suspected that the source of this population was the Warrenton Dunes stabilization project on the Clatsop Peninsula in Oregon near the mouth of the Columbia River by the Soil Conservation Service (now the Natural Resources Conservation Service) in 1935. Like European beachgrass, American beachgrass is dominant on the mobile sands of the foredune and rapidly spreads through rhizome fragments. American beachgrass occurs along the entire coast of Washington, ranging from Shi Shi Beach, Washington, in the north, to Sand Lake, Oregon, in the south, although its frequency decreases markedly at the northern and southern limits of this range. Currently, American beachgrass is the dominant introduced beachgrass species in much of the snowy plover range in the State of Washington (Seabloom and Wiedemann 1994).

Stabilizing sand dunes with introduced beachgrass has reduced the amount of unvegetated area above the tideline, decreased the width of the beach, and increased its slope. These changes have reduced the amount of potential snowy plover nesting habitat on many beaches and may hamper brood movements. In Oregon, the beachgrass community may provide habitat for snowy plover predators (e.g., skunks, weasels, coyotes, foxes, raccoons, and feral cats) that historically would have been largely precluded by the lack of cover in the dune community (Stern *et al.* 1991b, K. Palermo pers. comm. 1998).

On most beaches with snowy plover habitat, European beachgrass has caused the development of a vegetated foredune that effectively blocks movement of sand

inland and creates conditions favorable to the establishment of dense vegetation in the deflation plain, which occurs behind the foredunes (Wiedemann *et al.* 1969). In natural sand dunes, deflation plains consist of open sand ridges and flat plains at or near the water table. Thus, in areas with European beachgrass, the open features that characterize snowy plover breeding habitat are destroyed. The establishment of European beachgrass has also caused sand spits at the mouths of small creeks and rivers to become more stable than those without vegetation because of the creation of an elevated beach profile. This elevated profile, in effect, reduces the scouring of spits during periods of high run-off and storms. A secondary effect of dune stabilization has been human development of beaches and surrounding areas (Oregon Department of Fish and Wildlife 1994). This development, in turn, has reduced available beach habitat and focused human activities on a smaller area that must be shared with snowy plovers and other shorebirds.

On the Oregon coast, the establishment of European beachgrass has produced dramatic changes in the landscape (Oregon Department of Fish and Wildlife 1994). The spread of this nonnative species was greatly enhanced by aggressive stabilization programs in the State of Oregon in the 1930's and 1940's (Wiedemann 1987).

European beachgrass spread profusely along the Washington coast, and was well established by the 1950's (Washington Department of Fish and Wildlife 1995). In 1988, the spread of beachgrass was termed an "increasing threat" to traditional snowy plover nesting areas at Leadbetter Point, Washington, having become established where absent only 4 years earlier (Willapa National Wildlife Refuge 1988).

In California, there are many beaches where European beachgrass has established a foothold. These beaches include the dunes at Lake Earl, Humboldt Bay (from Trinidad to Centerville Beach), MacKerricher State Beach/Ten Mile Dunes Preserve, Manchester State Beach, Bodega Bay, Point Reyes National Seashore, Golden Gate National Recreation Area, Monterey Bay, Morro Bay Beach, Guadalupe-Nipomo Dunes, and Vandenberg Air Force Base (A. Pickart *in litt.* 1996). Chestnut (1997) studied the spread of European beachgrass at the

Guadalupe-Nipomo Dunes in San Luis Obispo County. He documented an increase in beachgrass from approximately 8 to 109 hectares (20 to 270 acres) between 1969 and 1997, and found that its rapid spread through native vegetation posed a serious threat to nesting snowy plovers and rare plants.

In addition to the loss of nesting habitat, introduced beachgrass may also adversely affect snowy plover food sources. Slobodchikoff and Doyen (1977) found that beachgrass markedly depressed the diversity and abundance of sand-burrowing arthropods at coastal dune sites in central California. Because snowy plovers feed on insects well above the high-tide line, the presence of this invasive grass may also result in loss of food supplies for plovers (Stenzel *et al.* 1981).

In some areas of California, such as the Santa Margarita River in San Diego County, and the Santa Clara and Ventura Rivers in Ventura County, giant reed (*Arundo donax*) has become a problem along riparian zones. During winter storms, giant reed is washed downstream and deposited at the river mouths where snowy plovers nest (Powell *et al.* 1997). Large piles of dead and sprouting giant reed eliminate nesting sites and increase the presence of predators, which use it as perches and prey on rodents in the piles of vegetation.

Other nonnative vegetation that has invaded coastal dunes, thereby reducing western snowy plover breeding habitat, includes Scotch broom (*Cytisus scoparius*), gorse (*Ulex europaeus*), South African iceplant (*Carpobrotus edulis*), and iceplant (*Mesembryanthemum* sp.). Shore pine (*Pinus contorta*) is a native plant species that has invaded coastal dunes and resulted in similar impacts to snowy plovers.

Many nonnative weed species also occur on and along San Francisco Bay salt pond levees, resulting in unsuitable nesting habitat for snowy plovers (J. Albertson *in litt.* 1999).

d. Habitat Conversion for Other Special Status Species

It is not known whether snowy plovers historically nested in San Francisco Bay prior to the construction of salt evaporator ponds beginning in 1860 (Ryan and

Parkin 1998). However, snowy plovers have wintered on the San Francisco Bay since at least the late 1800's, as indicated by a specimen dated November 8, 1889, in the California Museum of Vertebrate Zoology (Grinnell *et al.* 1918). It is possible that natural salt ponds in the vicinity of San Lorenzo once supported nesting birds, but insufficient data exist to assess this possibility (U.S. Fish and Wildlife Service 1992). Today, however, the San Francisco Bay recovery unit supports an important snowy plover source population, representing approximately 10 percent of the total breeding population. Feeney and Maffei (1991) observed a sizable population of snowy plovers at the Baumberg and Oliver salt ponds during the breeding and nonbreeding seasons, suggesting that these ponds are important to snowy plovers throughout the year. They suspected that these ponds are used by snowy plovers as both a pre-breeding and post-breeding staging area, based on the high numbers of plovers in mid-February and in late August/September, respectively.

As part of the Recovery Plan for Tidal Marsh Ecosystems of Central and Northern California, which we are currently preparing, extensive tidal marsh restoration is identified as a recovery action for listed and other sensitive species of tidal salt marshes including the California clapper rail (*Rallus longirostris obsoletus*) and salt marsh harvest mouse (*Reithrodontomys raviventris*). A large area of San Francisco Bay salt ponds, especially within the South Bay, are proposed for tidal marsh restoration for the benefit of tidal marsh dependent species listed under the Endangered Species Act. These salt ponds are large, persistent hypersaline ponds that are intermittently flooded with South Bay water. Some of these ponds currently provide valuable breeding and wintering habitat for snowy plovers. However, they occur within the historical areas of tidal salt marsh, which once dominated San Francisco Bay. Endangered tidal marsh species would benefit from conversion of these ponds to salt marsh; however, snowy plovers would lose suitable nesting and wintering areas. Therefore, this ecosystem plan also includes recommendations to support habitat needs of the snowy plover and California least tern (*Sterna antillarum browni*) on some of the existing salt ponds, through the maintenance of some salt ponds to be managed to provide snowy plover nesting and feeding habitats, including playas, salt flats, islands, and sparsely-vegetated levees.

In southern California, unless carefully planned, conversion of snowy plover habitat to tidal salt marsh may result in loss of snowy plover habitat. The light-footed clapper rail (*Rallus longirostris levipes*) inhabits coastal tidal marshes from Santa Barbara County south to Baja California, Mexico. Several locations in Ventura, Orange, and San Diego Counties provide nesting and/or wintering habitat for snowy plovers, but also provide high quality light-footed clapper rail habitat or represent high priority tidal marsh restoration sites in the recovery plan for the light-footed clapper rail (U.S. Fish and Wildlife Service 1985). These sites include Bolsa Chica, Agua Hedionda Lagoon, San Elijo Lagoon, San Dieguito Lagoon, and Los Penasquitos Lagoon.

2. Overutilization for Commercial, Recreational, Scientific, or Education Purposes

Egg collecting has been observed at several California nesting colonies (Stenzel *et al.* 1981, Warriner *et al.* 1986). Occasionally recreational birdwatchers may also harass plovers. The significance of these factors to nesting success is uncertain but probably relatively minor.

Qualified individuals may obtain permits to conduct scientific research and population census activities on snowy plovers under section 10(a)(1)(A) of the Endangered Species Act. Specific activities that may be authorized include: population censuses and presence/absence surveys; monitoring of nesting activity; capturing, handling, weighing, measuring, banding, and color-marking of young and adults on breeding and wintering grounds; radio-telemetry studies; translocation studies; genetic studies; contaminant studies; behavioral, ecological, and life history studies; and placing predator exclosures around active nests. Short-term impacts of these activities may include harassment and possible accidental injury or death of a limited number of individual plovers. The long-term impacts will be to benefit recovery of the species by facilitating development of more precise scientific information on status, life history, and ecology (U.S. Fish and Wildlife Service 1993b)

3. Disease and Predation

Predator density is a significant factor affecting the quality of snowy plover nesting habitat (Stenzel *et al.* 1994). Predation can result in the loss of adults, chicks, or eggs; separation of chicks from adults is also caused by the presence of predators. The snowy plover generally cannot defend itself or its nests against predation but must rely on antipredator adaptations, including (1) pale coloration of adults, eggs, and young, which acts as camouflage against detection by predators; (2) a skulking retreat from the nest at a predator's approach; (3) extreme mobility and elusiveness of precocial young; and (4) maintenance of low nesting density (Page *et al.* 1983). In natural ecosystems, there is a co-evolution of the predator-prey relationship, where prey species slowly evolve with evading behavior as predator species slowly evolve effective prey-capturing behavior. However, when exotic predators are introduced into the ecosystem and thrive there, they frequently occur in much higher densities and possess more effective strategies than native predators and, hence, usually have a more severe effect.

Predation has been identified as a major factor limiting western snowy plover reproductive success at many Pacific coast sites. Known predators of western snowy plover eggs, chicks, or adults include the following native species: gray foxes (*Urocyon cinereoargenteus*), Santa Rosa Island foxes (*Urocyon littoralis santarosae*), coyotes (*Canis latrans*), striped skunks (*Mephitis mephitis*), spotted skunks (*Spilogale putorius*), raccoons (*Procyon lotor*), California ground squirrels (*Citellus beecheyi*), long-tailed weasels (*Mustela frenata*), American crows (*Corvus brachyrhynchos*), common ravens (*Corvus corax*), ring-billed gulls (*Larus delawarensis*), California gulls (*Larus californicus*), western gulls (*Larus occidentalis*), glaucous-winged gulls (*Larus glaucescens*), American kestrels (*Falco sparverius*), peregrine falcons (*Falco peregrinus*), northern harriers (*Circus cyaneus*), loggerhead shrikes (*Lanius ludovicianus*), merlins (*Falco columbarius*), great horned owls (*Bubo virginianus*), burrowing owls (*Speotyto cunicularia*), great blue herons (*Ardea herodias*); and the following nonnative species: eastern red foxes (*Vulpes vulpes regalis*), Norway rats (*Rattus norvegicus*), Virginia opossums (*Didelphis marsupialis*), domestic and feral dogs (*Canis familiaris*), and cats (*Felis domesticus*).

Common ravens are known predators of snowy plover clutches at many locations, including: Coos Bay, Oregon (Wilson-Jacobs and Dorsey 1985); Salmon Creek Beach, Sonoma County (Point Reyes Bird Observatory unpublished data); Wilder State Beach, Santa Cruz County (George 1997); Santa Rosa Island (Stein 1993); San Diego County (Point Reyes Bird Observatory unpublished data); San Francisco Bay salt ponds (J. Albertson *in litt.* 1999); and Point Reyes National Seashore, where they are the main cause of nest loss (Point Reyes Bird Observatory unpubl. data). At Point Reyes, ravens took at least 34 of 60 nests in 1987, at least 38 of 60 nests in 1988, and at least 39 of 60 nests in 1989; in 1995, before protective steps were taken, they took 7 of 18 nests (Hickey *et al.* 1995). Corvids (ravens and crows) have also been a significant problem in southern California, with ravens taking a significant number of snowy plover eggs. In San Diego County, at least 22 of 179 nests were taken by ravens in 1996 (Powell *et al.* 1996), and at least 23 of 174 nests were taken by ravens and crows in 1997 (Powell *et al.* 1997). In 1991, high predation rates by common ravens occurred at the south spoil nesting area of the Coos Bay north spit, Oregon. The plovers responded by abandoning this nesting site, and moving remaining nesting efforts during the 1991 nesting season westward to the ocean beach (Stern *et al.* 1991b). Ravens probably also prey on snowy plover chicks, but not nearly to the extent that they do on eggs. After exclosures were used to protect plover nests from ravens on Point Reyes National Seashore in 1996, snowy plovers experienced high chick fledging rates relative to other coastal sites. At Waddell State Beach in 1994, a raven was observed taking a live killdeer (*Charadrius vociferus*) chick (D. George pers. comm. 1998), indicating they sometimes likely also take snowy plover chicks.

American crows have been documented preying on snowy plover nests at Atascadero Beach, San Luis Obispo County (Page 1990) and at Vandenberg Air Force Base, where they took at least 43 of 411 nests in 1997 (Persons and Applegate 1997). Crows were also one of the main predators of snowy plover nests at Vandenberg Air Force Base in 1998, where they took 19 nests (T. Applegate pers. comm. 1999). Crows have also been documented as predators of snowy plover eggs at locations along the Oregon coast (M. Stern pers. comm. 1999).

Gulls pose a special threat to breeding snowy plovers because they not only depredate nests and chicks, but also usurp and trample plover nesting habitat and crush eggs. Trampling of some nests by gulls has been frequently recorded at Vandenberg Air Force Base (Persons and Applegate 1997) and has been the cause of some nest loss in 13 of 16 years since 1983 at Monterey Bay (Point Reyes Bird Observatory unpublished data). Western and glaucous-winged gulls were primary predators of snowy plover chicks at Leadbetter Point (Widrig 1980). California gulls have trampled snowy plover nests and eaten eggs at San Francisco Bay locations (J. Albertson *in litt.* 1999). California gulls were major predators of snowy plover nests at Mono Lake, California (Page *et al.* 1983).

Loggerhead shrikes prey upon snowy plover chicks, but not eggs. Shrikes took at least 14 snowy plover chicks on a salt pan at the Pajaro River mouth in 1979 (Warriner *et al.* 1986). In 1996, a shrike was observed taking a chick from a hatching nest at the Salinas River National Wildlife Refuge (Page *et al.* 1997). In 1997, a shrike killed two chicks in an enclosure at Wilder State Beach (George 1997). In 1986 and 1987, loggerhead shrikes were regularly observed on the beach at the Pajaro River mouth during the chick fledging period and were suspected of taking most chicks before they reached fledging age; however, fledging success was also low in the same area in 1988 and could not be attributed to shrikes, which were not seen regularly there in that year (Page 1988). A loggerhead shrike was twice observed in one day attempting to take snowy plover chicks at San Francisco Bay salt ponds (Feeney and Maffei 1991). On these two occasions, however, the shrike was not successful because of persistent attacks by the tending male parent.

American kestrels are not known predators of snowy plover eggs. They are predators of chicks and possibly adults. A kestrel was observed capturing a 2-week-old snowy plover chick at Wilder State Beach in August 1989, and one was observed eating a snowy plover chick in the Moss Landing Wildlife Area on two occasions in August 1995 (D. George pers. comm. 1998). In 1998, a kestrel was observed hunting regularly where there were snowy plover broods in the Moss Landing Wildlife Area. During the period the kestrel was present at the pond, 43 chicks from 17 broods scheduled to fledge from June 11 to 24, had been banded. Only four chicks (9.3 percent) fledged. The kestrel disappeared unexpectedly, and

the fledging rate of broods increased dramatically. Of 105 banded chicks from 39 broods scheduled to fledge from June 25 to August 17, 67 chicks (63.8 percent) fledged. Later, Point Reyes Bird Observatory staff learned that a pair of kestrels had nested in a newly-erected nesting box about 0.4 kilometer (0.25 mile) from the brood-rearing area. Staff of Point Reyes Bird Observatory were invited to examine the contents of the nest box when it was being cleaned out and found bands for 12 snowy plover chicks in and below the box. The bands were from chicks scheduled to fledge from June 12 to June 20 (Page *et al.* 1998).

In 1997, a merlin with an adult snowy plover in its talons was observed flying from an enclosure at Salinas River National Wildlife Refuge. Within a period of a few days, 13 banded adults were found missing from the area. All were suspected of having been taken by the merlin, which was present in the area at the time. At the time of their disappearance, 10 of the 13 adults were nesting in enclosures and 3 were not (Page *et al.* 1997). Merlins are also probably effective predators of snowy plovers during the winter.

Snowy plovers are among the avian prey of the peregrine falcon (B. Walton pers. comm. 1998). In August 1996, a peregrine falcon was observed capturing a 27-day-old snowy plover chick from the ground at the Moss Landing Wildlife Area (D. George pers. comm. 1998). In San Francisco Bay, a peregrine falcon was seen taking an adult snowy plover at the Oliver North salt ponds; it was also seen at the Baumberg salt ponds, with 10 snowy plovers calling in alarm several meters (about 10 feet) away (Feeney and Maffei 1991).

Northern harriers are effective predators of snowy plover chicks. They may also take some adults. In 1987, 65 to 66 chicks hatched from 30 clutches on islands in the Salinas River. Subsequently, a harrier was observed hunting on the islands on several occasions. Of the 65 to 66 chicks, only 20 banded ones and 3 unbanded ones (34.8 to 35.4 percent) reached fledging age of 28 days. Of the 20 banded chicks, 12 were never seen off the islands and are presumed to have been eaten. Four adults caring for the chicks also disappeared. At the end of the nesting season, Point Reyes Bird Observatory staff visited the islands and found the eaten remains of two young snowy plovers and at least five other shorebirds on the ground (Point Reyes Bird Observatory unpubl. data). At the Moss Landing

Wildlife Area, a sharp drop in the fledging rate of snowy plover chicks was noticed after a harrier began foraging there. Prior to the appearance of the harrier, 61 percent of the chicks from 40 clutches fledged, compared to 23 percent of the chicks from 19 clutches subsequent to its appearance (Page *et al.* 1997).

In recent decades, alien eastern red foxes have become a serious new predator of endangered and threatened animals in coastal habitats (Jurek 1992, Golightly *et al.* 1994, Lewis *et al.* 1993). Nonnative red foxes were imported and released into the southern Sacramento Valley as early as the 1870's. The completion of the Transcontinental Railroad in 1869 allowed people to rapidly transport fish and wildlife from the eastern United States. The foxes might have been imported for sport hunting (fox chasing), for farmland rodent control, or for nostalgic reasons by the new settlers (Jurek 1992, Lewis *et al.* 1995). By the 1890's, red foxes in the Sacramento Valley were becoming plentiful and were being hunted and trapped for fur. In the 1920's, red foxes were being imported for the new endeavor of fox farming. By the 1930's, red foxes were widespread in the Sacramento Valley. By the 1970's, they were occurring in the Sacramento-San Joaquin Delta, and there were early indications of red fox populations in Los Angeles County. Although the spread of this alien species had been a gradual one for a century, an explosive spread was apparent from the 1970's into the 1980's, possibly from a combination of welfare relocations by landowners, animal welfare groups, and animal control entities; releases of unwanted captives or pets; and increasing red fox habitat offered by urbanization (Lewis *et al.* 1993). The fox apparently now occurs throughout a significant portion of coastal California, including Marin, San Mateo, Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, Ventura, Orange, and Los Angeles Counties (California Department of Fish and Game 1994). It also occurs at Monterey Bay (G. Page *in litt.* 1988) and San Francisco Bay (Harding *et al.* 1998), including the additional San Francisco Bay area counties of Napa, Solano, Contra Costa, Alameda, and Santa Clara (California Department of Fish and Game 1994).

Red foxes have been identified as a significant predator of snowy plover clutches in the Monterey Bay area, where they are also suspected of preying on adults and chicks. On Monterey Bay beaches, clutch hatching rates of snowy plovers declined steadily from 63 percent in 1984 to 33 percent in 1990 as red foxes

became a primary cause of clutch loss. Clutch losses attributed to red foxes rose from 4 in 1984, to 12 in 1985, to 34 in 1986. From 1986 to 1991, annual losses attributed to red foxes ranged from 22 to 57 clutches and represented 30 to 55 percent of all clutch losses. Since exclosures came into use to protect nests around Monterey Bay in 1992, losses to red foxes have ranged from zero to seven annually, and clutch hatching rates have climbed from 59 to 72 percent annually (Point Reyes Bird Observatory unpubl. data).

Coyotes are known predators of snowy plover clutches in the Pismo Beach/Santa Maria River area of San Luis Obispo County (T. Applegate pers. comm. 1996). They are the main nest predator of eggs on Vandenberg Air Force Base where they were the cause of 62 percent of all clutch losses attributed to predators from 1994 to 1997 (Persons and Applegate 1997). At Vandenberg Air Force Base, coyotes may be attracted to marine mammal carcasses on the beach early in the plover nesting season (Page and Persons 1995). Coyotes have also been identified as predators of plover nests at Mono Lake, California (Page *et al.* 1983).

Striped skunks have been recorded as predators of snowy plover clutches at Point Reyes National Seashore (Hickey *et al.* 1995), pocket beaches in northern Santa Cruz County (George 1997), Monterey Bay (Page *et al.* 1997), Morro Bay (Hutchinson *et al.* 1987), Santa Rosa Island (Stein 1993), and Coos Bay North Spit (Stern *et al.* 1991b). Skunks were believed to be the main cause of nest loss on Morro Bay Spit in 1987, the only year that the reproductive success of snowy plovers has been monitored at that location (Hutchinson *et al.* 1987). In the Monterey Bay area, small skunks occasionally squeeze through the fencing of exclosures and eat the plover's eggs (G. Page pers. comm. 1998).

Domestic and feral cats are widespread predators. The threat of predation of snowy plovers by cats increases when housing is constructed near snowy plover breeding habitat. As natural-appearing beaches continue to be surrounded by urban areas, snowy plovers will increasingly be subjected to this predator in the future. Cats are also one of the most common predators seen at California least tern nesting sites every year (R. Jurek pers. comm. 1999). At Venice Beach in southern California, cats are a constant threat to California least terns, which are found in habitat similar to that used by snowy plovers. This California least tern

colony had to be fenced to protect the terns from predators, including cats. When cats attempted to get over the fence, the fence had to be modified to further discourage entry by cats. Predation by cats is a major threat to snowy plovers; however, it is difficult to measure because of the difficulty in finding evidence of bird remains. Cats are known to take snowy plover adults and eggs. An adult snowy plover, found dead in 1994, was caught by a domestic cat at Buena Vista Lagoon, located between the mouth of the Santa Margarita River and Aqua Hedionda Lagoon (B. Farner pers. comm. in Powell and Collier 1994). During 1986, at the north spit of the Salinas River, two snowy plover clutches were lost to domestic cats (Page 1988).

Predation, while predominantly a natural phenomenon, is exacerbated through the introduction of nonnative predators and unintentional human encouragement of larger populations of native predators. Elevated predation pressures result from landscape-level alterations in coastal dune habitats which, in turn, now support increased predator populations within the immediate vicinity of nesting habitat for snowy plovers. Urbanization benefits red fox population growth by eliminating coyotes, which are the red fox's most serious native predator and competitor; by providing ready sources of food, water and denning sites; and by aiding dispersion of foxes into new areas. Red foxes disperse readily in urban areas because there are no serious predators besides the dog. Red foxes traverse most urban habitats, and readily cross busy highways and travel long distances underground through culverts (Lewis *et al.* 1993). Other predators, such as corvids, attracted by the presence of human activities (e.g., improper disposal of trash), may frequent beaches in increasing numbers. Gulls have greatly expanded their range and numbers, especially along the United States portion of the Pacific coast, as a result of human-supplied food sources (trash, fish offal, and dumps). Thousands of California gulls now breed in the southern part of San Francisco Bay, where only a few were present in the early 1980's (J. Albertson *in litt.* 1999). This population growth is attributed largely to the increase in landfills along the Bay within the last 20 years. Also, crows and ravens forage at landfills. Buick and Paton (1989) found that losses of hooded plover (*Charadrius rubricollis*) nests with human footprints around them were higher than at those without footprints, suggesting "that scavenging predators may use human footprints as a visual cue in locating food." Beach litter and garbage also attract predators such as skunks and coyotes.

Continued settlement of coastal areas by humans has generally supported increased populations of predators. Unnatural habitat features such as landscaped vegetation (e.g., palm trees), telephone poles, fences, buildings, and landfills near snowy plover nesting areas attract predators and provide them with breeding sites. These alterations all combine to make the coastal environment more conducive to various native and nonnative predators that adversely affect snowy plovers.

Substantial evidence exists that human activities are affecting numbers and activity patterns of predators on snowy plovers. For example, increased depredation of snowy plover nests by ravens at the Oliver Brothers salt pond, California, may be an indirect adverse impact of nearby installation of light structures by the California Department of Transportation and high-tension power lines by the Pacific Gas and Electric Company, thereby creating corvid nesting sites (G. Page pers. comm. 1997). On the Oregon coast, predation risk by mammals has increased as a result of the spread of European beachgrass, Scotch broom, and shore pine, which has transformed vast areas of open sand into dense grass-shrub habitat, providing excellent habitat for native and nonnative mammalian predators, such as skunks, raccoons, foxes, and feral cats (Stern *et al.* 1991*b*). At Vandenberg Air Force Base, coyote predation can be exacerbated by human presence when trash or debris is left behind (N. Read *in litt.* 1998). Also, widespread urbanization has depleted native predator habitat, bringing increased predatory pressure into the few undeveloped areas that are left, including habitat for snowy plovers and other sensitive species.

Widespread urbanization has depleted native predator habitat, bringing increased predation pressure into the few undeveloped areas that are left, including habitat for the snowy plover and other sensitive species. In heavily-developed areas in particular, habitat protected for sensitive species may be a “magnet” to native predators that have lost foraging habitat elsewhere. Continuing to remove predators from these areas effectively creates a “sink,” such that the need for ongoing predator removal never ends and negative ecological consequences occur over large areas beyond the boundaries of snowy plover nesting areas. Most predators having the greatest impacts on snowy plovers (e.g., coyotes, American kestrels) are territorial; if they, as individuals, can be deterred from preying on

snowy plovers, their eggs, and chicks, they may prove beneficial in excluding other conspecifics from plover nesting areas.

Signing and fencing of restricted areas on the beach may provide perches for avian predators of snowy plover adults or chicks. In 1995, corvids were known predators of plovers at the Siltcoos River area in Oregon, and there was evidence they used restrictive signs as perches (Hallett *et al.* 1995). Although signs and fences are important conservation tools in many areas, land managers need to be aware that modifications to them may be necessary to deter predators in some circumstances.

The U.S. Department of Agriculture, Wildlife Services Branch, has been involved in predator damage management for protection of threatened and endangered species for over 10 years in California. The management of nonnative red foxes has become a controversial issue in many areas of California, particularly in coastal habitats near urban areas (California Department of Fish and Game 1994). In November 1998, California voters approved Proposition 4, which banned the use of leghold traps in California. In February 1999, the U.S. District Court issued a Preliminary Declaratory Relief Order, which allows the use of padded leghold traps on Federal and non-Federal lands for the purpose of protecting threatened or endangered species. Trapping of nonnative and native predators of snowy plovers will therefore not be affected by Proposition 4 (J. Albertson *in litt.* 1999).

4. The Inadequacy of Existing Regulatory Mechanisms

The western snowy plover is protected by the Federal Migratory Bird Treaty Act (16 U.S.C. 703 et seq.) and by State law as a nongame species. The plover's breeding habitat, however, receives only limited protection from these laws (e.g., the Migratory Bird Treaty Act prohibition against taking "nests.") Listing of the snowy plover under State endangered species laws generally provides some protection against direct take of birds, and may require State agencies to consult on their actions, but may not adequately protect habitat. State regulations, policies, and goals include mandates both for protection of beach and dune habitat and for public recreational uses of coastal areas; consequently they may conflict

with protection of snowy plovers in some cases. Section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act are the primary Federal laws that could provide some protection of nesting and wintering habitat of the western snowy plover that is determined by the U.S. Army Corps of Engineers (Corps) to be wetlands or historic navigable waters of the United States. These laws, however, would apply to only a small fraction of the nesting and wintering areas of the western snowy plover on the Pacific coast. Aside from the Migratory Bird Treaty Act, snowy plovers have no protection status in Mexico.

To effectively recover the snowy plover, it is necessary to develop participation plans among cooperating agencies, landowners, and conservation organizations to assure protection and appropriate management of breeding, wintering, and migration areas. Since listing of the snowy plover in 1993, several local working groups have been developed and local governments and State and Federal agencies have cooperated extensively to implement a wide variety of snowy plover conservation actions. These partners continue to work to implement appropriate management of coastal areas for recovery of the snowy plover. These conservation efforts and the environmental policies of State and Federal agencies are described in greater detail in the Conservation Efforts section, below.

5. Other Natural or Manmade Factors Affecting Their Continued Existence

a. Natural Events

Snowy plover breeding and wintering habitat is subject to constant change from weather conditions. Stenzel *et al.* (1994) reported that the quality and extent of snowy plover nesting habitat is variable in both the short- and long-term. Coastal beaches increase in width and elevation during the summer through sand deposition, making marginal beaches more suitable for nesting later in the season. Over the longer term, an increase or decrease in habitat quality may occur after several years of winter storms. Based on the amount of flooding, the availability of dry flats at the edges of coastal ponds, lagoons, and man-made salt evaporators also varies within and between seasons. Therefore, the number of snowy plovers breeding in some areas may change annually or even over one breeding season in response to natural alterations in habitat availability (Stenzel *et al.* 1981).

Because most snowy plover nesting areas occur on unstable sandy substrates, nest losses caused by weather-related natural phenomena commonly occur. High tides and strong winds cause many nest losses. Events such as extreme high tides (Wilson 1980, Stenzel *et al.* 1981), river flooding (Stenzel *et al.* 1981), and heavy rain (Wilson 1980, Warriner *et al.* 1986, Page 1988) have been reported to destroy or wash away nests. The annual percentage of total nest losses attributed to weather-related phenomenon has reached 15 to 38 percent at some locations (Wilson 1980, Warriner *et al.* 1986, Page 1988).

Stormy winters can adversely affect the snowy plover. It is suspected that the severe storms occurring during the El Niño atmospheric and oceanic phenomenon of 1997/1998 winter caused a 10 to 30 percent decline in the 1998 snowy plover breeding population, depending on the coastal region. In all monitored recovery units, the number of breeding birds in 1998 was lower than in the 1997 nesting season. Additionally, a very wet spring resulted in a later than normal breeding initiation and fewer nesting attempts.

The snowy plover population naturally varies, both spatially and temporally, because of natural changes in weather and habitat conditions from year to year. However, human influences over the past century (e.g., habitat destruction, invasion of introduced beachgrass, and elevated predation levels) have reduced the plover's ability to respond to these natural perturbations.

b. Disturbance of Breeding Plovers by Humans and Domestic Animals

The increasing level of human recreation was cited as a major threat to the breeding success of the Pacific coast population of the western snowy plover (U.S. Fish and Wildlife Service 1993a). Also, human settlement and actions within coastal areas are affecting the numbers and activity patterns of predators of snowy plovers, to the detriment of the plovers. The coastal zone of the United States is home to over one-third of the U.S. human population, and that proportion is increasing (U.S. Fish and Wildlife Service 1995a). The coastal zone includes both open coastal areas and inland portions of coastal watersheds. The southern California coastal area, which constitutes the central portion of the snowy plover's coastal breeding range, attracts large crowds on a regular basis (see Figure 6).



Figure 6. Recreationists at Salt Creek Beach, California (photo by Ruth Pratt, with permission).

i. Pedestrians

Pedestrians (e.g., beach walkers and joggers) can cause both direct mortality and harassment of snowy plovers. Pedestrians on beaches may crush eggs or chicks and chase snowy plovers off their nests. Separation of plover adults from their nests and broods can cause mortality through exposure of vulnerable eggs or chicks to heat, cold, blowing sand, and/or predators. Pedestrians have been known to inadvertently step on eggs and chicks, deliberately take eggs from nests, and remove chicks from beaches, erroneously thinking they have been abandoned. People may also cause broods of snowy plovers to run away from favored feeding areas. Trash left on the beach by pedestrians also attracts predators. In addition to public pedestrians, military personnel using the beach for maneuvers, launches, and landings can also cause many of these adverse impacts to snowy plovers.

Beach-related recreational activities that are concentrated in one location (e.g., sunbathing, picnicking, sandcastle building, and birding/photography) can negatively affect incubating adult snowy plovers when these activities occur too close to their nests. Recreational activities that occur in the wet sand area (e.g., sand sailing) can adversely affect snowy plovers when they disturb plover adults

or broods, which feed at the edge of the surf. Recreational activities that occur in or over deep water may not directly affect snowy plovers; however, they can potentially be detrimental to plovers when recreationists use the beach to take a break from these activities, or as access, exit, or landing points. These recreational activities could include the beach- and water-oriented activities of surfing, kayaking, wind surfing, jet skiing, and boating, and the coastal-related recreational activity of hang gliding.

Concentrations of people may deter snowy plovers and other shorebirds from using otherwise suitable habitats. Anthony (1985) found that intensive human activity at Damon Point had a “bracketing effect” on the distribution of nesting snowy plovers, confining their breeding activity to a section of the spit and precluding their regular use of otherwise suitable habitat. Fox (1990) also found that snowy plovers avoided humans at Damon Point, and the presence of fishermen and beachcombers kept them hundreds of yards away from potential habitat. Because early-nesting snowy plovers have narrower beaches from which to select nest locations, recreational use may be more concentrated in the limited habitat available. Also, repeated intrusions by people into snowy plover nesting areas may also cause birds to move into marginal habitats where their chances of reproductive success are reduced. Studies of the Atlantic coast population of the piping plover (*Charadrius melodus*), an East coast species with habitat requirements very similar to the snowy plover, indicate that some piping plovers that nest early in the season are forced to move elsewhere when human use becomes too intense (Cairns and McLaren 1980). These authors concluded that piping plovers that nest early before beaches become heavily used for recreation, “cannot predict and avoid reproductive failure in habitats that otherwise appear suitable to them.” Burger (1993) observed that piping plovers, in response to human disturbance, spent more energy on vigilance and avoidance behavior at the expense of foraging activity, and sometimes abandoned preferred foraging habitat.

Page *et al.* (1977) observed snowy plovers’ response to human disturbance at two coastal beaches where normal beach use ranged from light to heavy. The study included 156 hours of observation at 15 snowy plover nests. At Point Reyes, they found that pedestrians disrupt incubation of nests. When humans approached snowy plovers, adults left their nests 78 percent of the time when people were

within 1 to 50 meters (3 to 164 feet); 65 percent of the time when people came within 50 to 100 meters (164 to 328 feet); and 34 percent of the time when people were within 100 to 250 meters (328 to 820 feet). They also found that plovers' reaction to disturbance by humans varied, ranging from one bird remaining off the nest for less than 1 minute when a person walked within 1 meter (3 feet) of the nest on a heavily-used beach to another plover leaving the nest when three people were 200 meters (656 feet) away on a less-used beach. They noted that "birds exposed to prolonged human activity near the nest seemed to become accustomed to it." It has been speculated that predators of plovers may benefit from a decline in wariness by plovers nesting on beaches that are subject to ongoing high levels of human disturbance (Persons and Applegate 1997).

Fahy and Woodhouse (1995) quantified the levels of recreational disturbance, their effect on snowy plovers, and the effectiveness of the Linear Restriction Program at Ocean Beach, Vandenberg Air Force Base. Randomized observations of four study plots covered 71 days, with the majority lasting 90 minutes. Overall plover responses to activities occurring within and outside the restriction area were recorded. The disturbance types that caused incubating snowy plovers to flush from their nests most frequently were joggers and walkers, followed by joggers or walkers with dogs off leash, and stationary visitors. The disturbance types that kept incubating snowy plovers off their nests for the longest period of time were stationary visitors and surf fishermen, probably because of the duration of these stationary disturbances that occurred close to nests.

Signs warn visitors not to cross the Linear Restriction Boundary into dune habitat used by plovers. Seventy percent of all disturbances were in compliance and 30 percent in noncompliance with this restriction. The disturbance types that were most and least frequently in compliance with the boundary were joggers or walkers and stationary visitors, respectively. All-terrain vehicles caused the most significant alert and flight behaviors by plovers, even though they were in compliance with the Linear Restriction. The authors of this study also predicted that "the closer the disturbance occurs to the plover, the more severe the plover response." Plover responses to disturbance types ranged from approximately 1 meter (3 feet) for flight responses to 130 meters (426 feet) for alert responses. Weekends accounted for 60 percent of all disturbances. The effectiveness of

enforcement personnel was limited; their presence was documented during only 14 percent of all identified disturbances.

At the Pajaro River mouth in California, at least 26 of 189 snowy plover clutches, representing 14 percent of the observed clutches, were destroyed by being driven over, stepped on, or deliberately taken by people (Warriner *et al.* 1986). Since exclosures have been used to protect nests at the Pajaro River mouth and other locations at Monterey Bay, a few nests have still been deliberately destroyed by vandals in most years (Point Reyes Bird Observatory unpublished data). At South Beach, Oregon, the number of snowy plovers declined from 25 in 1969 to 5 in 1979 to 0 by 1981 when a new park was constructed next to the beach and the adjacent habitat became more accessible to vehicles and people (Hoffman 1972 *in* Oregon Department of Fish and Wildlife 1994). At Vandenberg Air Force Base, snowy plover monitoring during 1993 at South Beach (where recreational use was high) and North Beach (where recreational use was low) found the rate of nest loss caused by humans differed markedly: 24.3 percent of South Beach nests were lost compared to only 3.0 percent of North Beach nests (Persons 1994). Persons and Applegate (1997) reported that “rates of reproductive success, combined for 1994 through 1997, were substantially higher on North Beach than on South Beach.” This difference occurred despite the fact that nesting habitat was posted as off-limits in 1994.

Loss of snowy plover chicks also may occur because of human activities. The number of young produced per nesting attempt increased from 0.75 in disturbed habitat to 2.0 for nests free of disturbance at Willapa National Wildlife Refuge, Washington (Saul 1982). At Vandenberg Air Force Base, the 1997 fledging success of snowy plovers was 33 to 34 percent on North Beach where recreational activity is restricted and only 12 percent on South Beach where recreational use is high (Persons and Applegate 1997).

Hoopes *et al.* (1992) quantified human use and disturbance to piping plovers in Massachusetts during the 1988 and 1989 nesting seasons. They found pedestrians caused piping plovers to flush or move at an average distance of 23 meters (75 feet). Pedestrians within 50 meters (164 feet) of the birds caused piping plovers to stop feeding 31 percent of the time.

Flemming *et al.* (1988) measured the effects of human disturbance on reproductive success and behavior of piping plovers in Nova Scotia. To assess human disturbance, they recorded positions of people, pedestrian tracks, and vehicle tracks, then defined classes based on visits per week. They found significantly fewer young survived in areas of high versus low disturbance; humans elicited a significantly higher response level from adult piping plovers than did predators or nonpredatory species; chicks fed less and were brooded less when humans were within 160 meters (525 feet); and chick peck rate during feeding was lower when humans were present. They speculated that because chicks shifted from feeding and energy conservation activities to vigilance and cryptic predator avoidance behaviors, their energy reserves would be depleted, making them more susceptible to predators and inclement weather. They postulated that a decline in piping plover abundance in Nova Scotia could be caused by human disturbance altering chick behavior. Fewer chicks survived to 17 days in areas heavily disturbed by humans.

Schulz and Stock (1993) studied the effects of tourism on colonization, distribution, and hatching success of Kentish plovers (*Charadrius alexandrinus alexandrinus*), a Eurasian subspecies of the snowy plover, at the Wadden Sea in Germany. They measured disturbance intensity by counting and mapping tourists on 50 days from April to July, during times of peak human activity (1500 to 1600 hours) and in intervals of 30 minutes throughout other days. An index of person-hours per area per day was calculated. They found that Kentish plovers did not colonize heavily-disturbed areas and that resting and sunbathing people were apparently more disruptive than walking people because the latter generally followed the high-tide line. Clutch losses were lowest in areas with little disturbance and highest in areas with heavy disturbance. They indicated that hatching success in highly disturbed areas, even with optimal habitat, is as low as in poor habitat with a low level of disturbance.

ii. Dogs

Dogs on beaches can pose a serious threat to snowy plovers during both the breeding and nonbreeding seasons. Unleashed pets, primarily dogs, sometimes chase snowy plovers and destroy nests. Repeated disturbances by dogs can

interrupt brooding, incubating, and foraging behavior of adult plovers and cause chicks to become separated from their parents. Pet owners frequently allow their dogs to run off-leash even on beaches where it is clearly signed that dogs are not permitted or are only permitted if on a leash. Enforcement of pet regulations on beaches by the managing agencies is often lax or nonexistent.

A number of examples of disruptive ways that dogs affect snowy plovers have been noted at beaches in Monterey County (Marina State Beach), Santa Cruz County (Laguna, Scott Creek, and Seabright Beaches) and San Mateo County (Half Moon Bay and Pacifica Beaches) (D. George pers. comm. 1997). Incubating birds have been flushed from nests by dogs, including nests located inside areas protected by symbolic fencing. Dogs have also displaced adults from nests with newly-hatched chicks. Roosting and feeding flocks, as well as individual birds, have been deliberately and persistently pursued by dogs. At Laguna Creek Beach, California, a three-egg snowy plover nest was trampled and destroyed by a dog in 1990 (D. George pers. comm. 1997). At Zmudowski State Beach, a dog stepped on and destroyed two of three eggs in one nest in 1998 (Point Reyes Bird Observatory unpublished data). Also in 1998, two of three eggs in a nest at Salinas River State Beach were destroyed by dogs (Gary Page pers. comm. 1998). The latter two instances occurred in areas protected by symbolic fencing. Feral dogs are suspected to have disturbed snowy plover nests and chicks on San Francisco Bay salt ponds in 1998 (J. Albertson *in litt.* 1999).

Even when not deliberately chasing birds, dogs on a beach may disturb snowy plovers and other shorebirds that are roosting or feeding. Page *et al.* (1977) found that snowy plovers flushed more frequently and remained off their nests longer when a person was accompanied by a dog than when alone. They collected data during 156 hours of observation at 15 nests at Point Reyes, California, and found the following distances at which snowy plovers flushed from their nests as a result of disturbance by people versus people *with* dogs. At 1 to 50 meters (3 to 164 feet), people alone caused flushing 78 percent of the time, while people with dogs caused flushing 100 percent of the time. At a distance of 50 to 100 meters (164 to 328 feet), people alone caused flushing 57 percent of the time, while people with dogs caused flushing 65 percent of the time. At a distance of 100 to 250 meters (328 to 820 feet), people alone caused flushing 34 percent of the time, while

people with dogs caused flushing 52 percent of the time (Page *et al.* 1977). Fahy and Woodhouse (1995) found that joggers or walkers with off-leash dogs caused a significantly greater number of avoidance responses from snowy plovers than other types of disturbances at Ocean Beach, Vandenberg Air Force Base, California.

At wintering sites such as Ocean Beach in San Francisco, California, off-leash dogs have caused frequent disturbance and flushing of snowy plovers and other shorebirds. Off-leash dogs chase wintering snowy plovers at this beach and have been observed to regularly disturb and harass birds (P. Baye pers. comm. 1997). Observations by National Park Service volunteers suggest that unleashed pets represent the most significant recreational threat to wintering snowy plovers and migratory shorebirds at Ocean Beach, because of the prolonged and repeated disturbance created when they chase birds (Hatch 1997). In 1995 and 1996, during 45 hour-long observations of wintering flocks of snowy plovers at Ocean Beach, people approaching within 15 meters (50 feet) of snowy plovers caused the plovers to run, walk, or fly in 56 percent of 185 instances. By comparison, plovers responded by moving in 73 percent of 74 instances when dogs with or without people approached to within 15 meters (50 feet) (Golden Gate National Recreation Area unpublished data). When shorebirds are flushed, they must spend more energy on vigilance and avoidance behaviors at the expense of foraging and resting activity (Burger 1993, Hatch 1997). Disruption of foraging and roosting may result in decreased accumulation of energy reserves necessary for shorebirds to complete the migration cycle and successfully breed (Burger 1986, Pfister *et al.* 1992). Dog disturbance at wintering and staging sites, therefore, may adversely affect individual survivorship and fecundity, thereby affecting the species at the population level.

On the East coast of the United States, dogs are also known to chase piping plovers as well as kill chicks. During a study conducted on Cape Cod, Hoopes *et al.* (1992) found that the average distance at which piping plovers were disturbed by pets was 46 meters (151 feet), compared to 23 meters (75 feet) for pedestrians. Furthermore, the birds reacted to the pets by moving an average of 57 meters (187 feet), compared to 25 meters (82 feet) when the birds were reacting to a pedestrian. The duration of the disturbance behavior stimulated by pets (53

seconds) was also significantly greater than that caused by pedestrians (29 seconds). Pets within 50 meters (164 feet) of the birds caused piping plovers to stop feeding 52 percent of the time (Hoopes *et al.* 1992). In 1994, a dog that was removed from its leash after passing piping plover chicks within an area marked by symbolic fencing swiftly returned to the fenced area and killed a plover chick (Melvin *in litt.* 1997).

iii. Motorized Vehicles

Unrestricted use of motorized vehicles on beaches is a threat to snowy plovers and their habitat. Motorized vehicles may affect remote stretches of beach where human disturbance would be slight if access were limited to pedestrians. The magnitude of this threat is variable, depending on level of use and type of terrain covered. Use of motor vehicles on coastal dunes may also be destructive to dune vegetation, especially sensitive dune plant species.

Driving vehicles in breeding habitat may cause destruction of eggs, chicks, and adults, abandonment of nests, and considerable stress and harassment to plover family groups. In California and Oregon, vehicle tracks have been found near nests at a number of beaches and there have been some instances of vehicles crushing nests, chicks, and adults. In the Monterey Bay area, two male snowy plovers were run over while incubating eggs (G. Page pers. comm. 1997, J. P. Myers *in litt.* 1988). At McGrath State Beach (Mandalay Bay/Santa Clara River mouth), two snowy plover chicks were found to have been crushed by vehicles (J.B. Price *in litt.* 1992). In addition to recreational vehicles, vehicles used for military activities have also incurred snowy plover mortality. Eggs at Coronado Naval Amphibious Base were run over by a vehicle, and another nest was destroyed by an air-cushioned landing craft at Camp Pendleton Marine Corps Base (Powell *et al.* 1995, 1997). A snowy plover chick may have died of exhaustion at Camp Pendleton Marine Corps Base after trying to escape disturbance by climbing over deep ruts left by amphibious tracked vehicles (Powell *et al.* 1997). At Vandenberg Air Force Base, two snowy plovers (one adult and one chick) were killed when run over by a security vehicle (Persons 1994). Off-road vehicles at Coos Bay North Spit, Oregon, ran over one clutch and scattered broods from other nests (Stern *et al.* 1990b). Although vehicle

traffic was prohibited on the beach west of Floras Lake, Oregon, all-terrain vehicle tracks were observed only 15 centimeters (6 inches) away from unprotected nests with eggs on two occasions during the 1993 breeding season; regular violations of the closure to vehicle traffic at the Tenmile estuary were also noted (Casler *et al.* 1993). In Washington, vehicle tracks have been noted in nesting areas at Leadbetter Point and Midway Beach (S. Richardson pers. comm. 1998). Widrig (1980) reported that, in 1978, human disturbance at Willapa National Wildlife Refuge, Leadbetter Point, was heavy at times, primarily from motorcycles and four-wheel drive vehicles. The nesting area was closed during the 1979 nesting season. The number of young fledged per nesting pair increased from 0.3 in 1978 to 1.2 in 1979.

Driving motor vehicles at night seems to be particularly hazardous to snowy plovers. Drivers of all-terrain vehicles at night have run over and killed snowy plover adults at Vandenberg Air Force Base, and State park ranger patrol vehicles have crushed snowy plover chicks at Oceano Dunes State Vehicular Recreation Area during night patrols (R. Mesta *in litt.* 1998).

Snowy plover adults and chicks have been observed using tire tracks and human footprints for loafing at Camp Pendleton and the Naval Air Base at Coronado (Powell and Collier 1994). This behavior increases their chances of being run over. Snowy plover chicks also may have difficulty getting out of tire ruts, thereby increasing their likelihood of being run over. Their cryptic coloring and habit of crouching in depressions like tire tracks makes snowy plover chicks especially vulnerable to vehicular traffic. In Massachusetts, between 1989 and 1997, a total of 25 piping plover chicks and 2 adults were found dead in off-road vehicle tire ruts on the upper beach between the mean high tide line and the foredune (U.S. District Court of Massachusetts 1998).

Buick and Paton (1989) assessed the impact of off-road vehicles on nest attentiveness and nesting success of hooded plovers (*Charadrius rubricollis*), a similar plover species in south Australia. They patrolled 71 kilometers (44 miles) of beach using four-wheel-drive vehicles or motorbikes every 3 to 4 or 8 to 10 days (depending on the beach) and recorded hooded plover numbers and odometer readings. Density of vehicle tracks was determined from positions and widths of

tracks on random transects, primarily “to estimate the proportion of the beach that had been run over at least once.” Based on the density of vehicle tracks observed, they found an 81 percent probability that hooded plover nests would be run over during incubation.

Hoopes *et al.* (1992) found off-road vehicles caused piping plovers to flush or move at an average distance of 40 meters (131 feet). Off-road vehicles within 50 meters (164 feet) of the birds caused piping plovers to stop feeding 77 percent of the time. While most responses by piping plovers to off-road vehicles resulted in movement by the birds, they observed three instances where the plovers “froze” in response to the off-road vehicles. Both types of responses have a negative impact on plovers through either disturbance, interruption of feeding behavior, or increasing the risk that piping plovers will be hit or crushed by vehicles.

Flemming *et al.* (1988) found that adult piping plover behavior in Nova Scotia was not appreciably altered by vehicles. However, the primary focus of their study was the effects of pedestrian disturbance on reproductive success and behavior of piping plovers.

At wintering sites, disturbance from motorized vehicles may harass snowy plovers and disrupt their foraging and roosting activities, thereby decreasing energy reserves needed for migration and reproduction. When motorcycles, most of which were in the wet sand zone, were driven at high speed along Ocean Beach in San Francisco, Hatch (1997) observed that snowy plovers and other shorebirds were continually disturbed and often took flight.

iv. Beach Cleaning

Removal of human-created trash on the beach is desirable to reduce predation threats by eliminating food for predators of snowy plovers; however, the indiscriminate nature of mechanized beach-cleaning adversely affects snowy plovers and their habitat. Mechanized beach cleaning can be dangerous to plovers by crushing their clutches and chicks or causing prolonged disturbance from the machine’s noise. Also, this method of beach cleaning removes the birds’ natural wrackline (area of beach containing seaweed and other natural wave-cast organic

debris) feeding habitat, reducing the availability of food. Kelp and driftwood, with their associated invertebrates, are regularly removed and the upper layer of sand is disturbed. Beach grooming also alters beach topography, removes objects associated with snowy plover nesting, and prevents the establishment of native beach vegetation (J. Watkins *in litt.* 1999). In all of Los Angeles County and parts of Ventura, Santa Barbara, and Orange Counties, California, entire beaches are raked on a daily to weekly basis. Large rakes, with tines 5 to 15 centimeters (2 to 6 inches) apart, are dragged behind motorized vehicles from the waterline to pavement or to the low retaining wall bordering the beaches (Stenzel *et al.* 1981). Even if human activity was low on these beaches, grooming activities completely preclude the possibility of successful snowy plover nesting (Powell 1996).

v. Equestrian Traffic

Horseback riders on the beach sometimes enter coastal dunes or upper beach areas (see Figure 7), where they may crush clutches or disturb plovers. The following clutch losses in Monterey Bay were attributed to trampling by horses: one each in 1984, 1987, 1989, and 1991; two in 1986; and three in 1993 (Point Reyes Bird Observatory unpublished data). Equestrians were suspected of being the cause of no nesting at Wilder Beach in 1988 (Page 1988). During the 1994 breeding season, frequent noncompliance by equestrians was observed within the linear closure area of snowy plover nesting habitat at Vandenberg Air Force Base (Persons 1995). During Memorial Day weekend at Baker Beach, Oregon, Woolington (1985) observed that most of the horseback riders stayed on the hard-packed sand near the edge of the surf; however, she observed three riders who rode through snowy plover nesting habitat within the dune hollows. At New River, Oregon, Craig *et al.* (1992) observed a snowy plover nest that was almost destroyed by a pair of horseback riders before the plover surveyors had time to construct an enclosure around the nest. Unleashed dogs have also been associated with equestrians.



Figure 7. Equestrians on beach (photo by U.S. Forest Service, with permission).

vi. Fishing

Impacts on snowy plover nesting may be associated with surf fishing and shellfish harvesting in and near plover habitat. The improper disposal of offal (waste parts of a butchered animals, e.g. fish), bait, and other litter attracts crows, ravens, and gulls, which are predators of plover eggs and chicks. Also, plovers may become entangled in discarded fishing lines (G. Page pers. comm. 1998). Persons and Applegate (1997) noted that flocks of gulls were often seen near parties of surf fishermen at Surf Beach, Vandenberg Air Force Base. Gull tracks were traced to trash discarded by anglers and other recreationists. They suspected that many of the snowy plover nests destroyed by gulls during 1997 were discovered while the gulls were scavenging. Fahy and Woodhouse (1995) found that stationary visitors and surf fishermen kept incubating snowy plovers off their nests longer than other types of disturbance at Ocean Beach, Vandenberg Air Force Base, probably because of the longer duration of these stationary disturbances. They also found that stationary visitors and surf fishermen were more frequently in noncompliance with the Linear Restriction than people engaged in other recreational activities. Anglers and other recreationists use dunes as toilets, attracting scavengers into nesting areas at Vandenberg Air Force Base even though the dunes are signed as closed to the public (R. Mesta *in litt.* 1998).

Surf fishing is a commercial enterprise in many coastal locations, including the ocean smelt fishery in northern California (C. Moulton *in litt.* 1997). Recreational surf fishing occurs throughout the California coast. In Humboldt County, California, Redwood National and State Parks have proposed allowing beach vehicle use, by annual permit, for commercial fishing and tribal fishing/gathering on Gold Bluffs Beach, Freshwater Spit, and Crescent Beach (J. Watkins *in litt.* 1999). In the State of Washington, the most popular season for surf fishing is April through July (Washington Department of Fish and Wildlife 1995). At present, demand for surf perch fishing is relatively low in Oregon. However, the Oregon Department of Fish and Wildlife is promoting a surf perch fishery to lessen the demand for anadromous fishing. This fishery would increase vehicle driving to remote and relatively undisturbed sites used by snowy plovers (K. Palermo *in litt.* 1998a).

Because the earliest snowy plover clutches in Washington are laid between mid-April and mid-May, harvesting of razor clams during the mid-March to mid-May clamming season may have adverse impacts on prospecting or nesting snowy plovers. Clammers near nesting areas may disturb adults and chicks; human activity in feeding areas may restrict plover foraging activity, and increased motorized traffic may increase the risk of nest and chick loss (Washington Department of Fish and Wildlife 1995). However, observations of snowy plover and human activities during the spring 1995 razor clam season showed clamming had no visible impact on plovers where clamming intensity was low (Kloempken and Richardson 1995). Instances of trespassing into the snowy plover protection area were noted; however, movement of the snowy plover protection area boundary about 327 meters (1,073 feet) west of its previous location seemed to benefit the birds by providing more space between them and pedestrian and vehicular disturbances.

vii. Fireworks

Fireworks are highly disturbing to snowy plovers. At Del Monte Beach, California, a snowy plover chick hatched on July 4, 1996, within an area demarcated by symbolic fencing and was abandoned by its parents after a fireworks display. Disturbance from the noise of the pyrotechnics is exacerbated

by disturbance caused by large crowds attracted to fireworks events. California Department of Parks and Recreation staff estimated that 6,000 people visited Del Monte Beach on that day. Because of the extensive disturbance, the adult plovers left the nest site with two chicks, abandoned the third chick, and were not seen again (K. Neumann pers. comm. 1997). During July 4, 1992, observations of piping plovers that nest on the Breezy Point Cooperative and adjacent beaches of Gateway National Recreation Area in Queens, New York, the birds were disturbed by fireworks displays (Howard *et al.* 1993). Management recommendations for this area included prohibition of fireworks in or near the fenced and posted nesting and brood-rearing areas (Howard *et al.* 1993).

viii. Falconry, Kite Flying, and Model Airplanes

The sport of training falcons for hunting could result in losses of snowy plovers when it introduces predators to snowy plover habitats.

Biologists believe plovers perceive kites as potential avian predators. The reaction of snowy plovers to kites at Ocean Beach in San Francisco, California, “ranged from increased vigilance while roosting in close proximity to the kite flying, to walking or running approximately 10 to 25 meters (33 to 82 feet) away and resting again while remaining alert” (Hatch 1997). It is expected that stunt-kites would cause a greater response from plovers than traditional, more stationary kites. Stunt kites include soaring-type, two-string kites with noisy, fluttering tails, which often exhibit rapid, erratic movements.

Hoopes *et al.* (1992) found that piping plovers are intolerant of kites. Compared to other human disturbances (i.e., pedestrian, off-road vehicle, and dog/pet), kites caused piping plovers to flush or move at a greater distance from the disturbance, to move the longest distance away from the disturbance, and the duration of the movement was the longest. Piping plovers responded to kites at an average distance of 85 meters (279 feet); moved an average distance of over 100 meters (328 feet); and the average duration of the response was 70 seconds.

It is expected that model airplanes would also have a detrimental impact to snowy plovers because plovers may perceive them as potential predators (Hatch 1997).

ix. Aircraft Overflights

Low-flying aircraft (e.g., within 152 meters (500 feet) of the ground) can cause disturbances to breeding and wintering snowy plovers. Hatch (1997) found that all types of low-flying aircraft may potentially be perceived by plovers as predators. She also found that the general response of roosting snowy plovers to low-flying aircraft at Ocean Beach, San Francisco, California, was to increase vigilance and crouch in depressions on the beach, whereas foraging plovers frequently took flight. Federal Aviation Regulations, Part 91, General Operating and Flight Rules, require that over open water, aircraft may not be operated closer than 152 meters (500 feet) to any person, vessel, vehicle, or structure. However, helicopters may be operated at less than 152 meters (500 feet) if the operation is conducted without hazard to people or property on the surface (U.S. Department of Transportation, Federal Aviation Administration, 1977). Emergency operations, including those by Coast Guard helicopters, are exempted from these rules.

Helicopters can cause excessive noise, which can also disturb plovers, even at an altitude of 152 meters (500 feet). Fish and Wildlife Service and Vandenberg Air Force Base personnel have observed helicopters flush incubating snowy plovers during pre-launch security sweeps at Vandenberg Air Force Base; these helicopter flights were directed not to overfly nesting habitat, and were to be at least 152 meters (500 feet) above mean sea level (J. Watkins *in litt.* 1999). During observations of piping plovers that nest on the Breezy Point Cooperative and adjacent beaches of Gateway National Recreation Area in Queens, New York, small fixed-wing aircraft, and especially helicopters, often caused foraging piping plovers to stop feeding and crouch or run (Howard *et al.* 1992). At Camp Pendleton Marine Corps Base, California, military training aircraft (including helicopters) are only required to fly at a minimum altitude of 91 meters (300 feet) above ground level during the period April 15 to August 31, in areas that support snowy plover and California least tern habitat (D. Stadtlander pers. comm. 1999).

x. Special Events

Special events, including media events, sporting events, and beach clean-ups, which attract large crowds, have a potential for significant adverse impacts when held in or near snowy plover habitat. An example is the National Marine Debris Monitoring Program, implemented by the U.S. Environmental Protection Agency in conjunction with the National Oceanic and Atmospheric Administration, National Park Service, and the U.S. Coast Guard. This year-round program uses volunteers (including high school students) to document and collect trash and marine debris on coastal transects within snowy plover nesting and wintering habitat. Potential threats from crowds of people attracted to special events are similar to those previously identified for pedestrians, including direct mortality and harassment of snowy plovers.

xi. Coastal Access

Expanding public access to the coast (e.g., State Coastal Trails) for recreation (e.g., walking, hiking, biking) may adversely affect snowy plovers and their breeding or wintering habitat. Expanded coastal access brings significantly greater numbers of people to the beach and other coastal habitats, exacerbating potential conflicts between human recreational activities and plover habitat needs (see Pedestrian section). Expanded coastal access may exceed the threshold of beach visitors that public resource agencies (e.g., State Parks and National Park Service) can effectively manage while also meeting their responsibilities to protect natural resources.

Bicycles are known to adversely affect snowy plovers nesting on levees and roads near San Francisco Bay salt ponds within the Don Edwards San Francisco Bay National Wildlife Refuge. Many of these levees are closed to human access, but some bicyclists trespass onto closed levees. In 1998, one snowy plover nest, located on the main access road to the Refuge, was run over by a bicycle as biologists were putting up a barrier to protect it (J. Albertson *in litt.* 1999).

xii. Livestock Grazing

Snowy plover nests have been trampled by cattle. On Santa Rosa Island, California, 4 nests were trampled by cattle and 1 nest was trampled by horses, resulting in the loss of at least 10 eggs during a 2-year study conducted by the National Park Service in 1992 to 1993. In addition to direct mortality from livestock, incubating snowy plovers were observed to flush from nests when cattle passed within 15 meters (49 feet). On one occasion, the adult bird was off the nest for over 28 minutes when a steer laid down next to the nest. Livestock on Santa Rosa Island also frequently use a lagoon in the Skunk Point area that is an important feeding area for pre-fledged snowy plover chicks. Fouling the water and trampling its adjacent shoreline may adversely affect snowy plover foraging habitat (U.S. Fish and Wildlife Service *in litt.* 1995). On Santa Cruz Island, feral pigs may trample snowy plover habitat and disturb nesting plovers (R. Klinger pers comm. 1998).

c. Oil Spills

Oil spills threaten snowy plovers throughout their life cycle. Snowy plovers forage along the shoreline and in sea wrack (seaweed and other natural wave-cast organic debris) at the high-tide line and thereby risk exposure to oil during spills. Often, plovers get oil on their feet and transfer it to their feathers when they draw their feet into their plumage while roosting (G. Page pers. comm. 1997). Oil spills may result in contamination of snowy plover food sources when oiled wrack is left on the beach. Adverse impacts to plovers may also occur during oil clean-up and remediation activities if response teams are not careful when driving heavy equipment and vehicles or traversing on foot through plover habitat.

The loss of thermal insulation is acknowledged to be the primary cause of mortality in oiled birds (National Research Council 1985, Leighton 1991). Oiled feathers lose their ability to keep body heat in and cold water out, causing reduced insulation, increased metabolic rate, and hypothermia. Swallowing small amounts of preened oil may lead to physiological changes in birds, including pathological effects on the alimentary tract, blood, adrenal glands, kidneys, liver, and other organs. Reproductive performance may also be impaired. There is evidence that

ingested oil causes delayed maturation of ovaries, altered hormone levels, thinning of eggshells, reduced survival of eggs and chicks, reduced chick growth, and abandonment of nests by adults (Burger and Fry 1993). Oil transferred to eggs from plumage or feet of incubating birds can kill embryos (Albers 1977, Albers and Szaro 1978, King and Lefever 1979). Oil or other chemicals washed onto mudflats or sand beaches may also result in reduction of the availability of invertebrate prey (Kindinger 1981). Evans and Keijl (1993) found that following the Gulf War, 44 percent of 522 Kentish plovers (*Charadrius alexandrinus alexandrinus*) within areas of the Saudi Arabian coast affected by the 1991 spill were heavily oiled (i.e., more than 10 percent of plumage oiled). Heavily-oiled wading birds were found to be significantly lighter in weight than unoiled waders, and it was suspected they were unlikely to migrate successfully or breed during that year because of losses in energy reserves.

Surveys of beached birds have shown that small-volume, chronic oil pollution is an ongoing source of avian mortality in coastal regions (Burger and Fry 1993). Crude oil is transported from offshore platforms along the California coast. Potential adverse effects to snowy plovers could occur from the oil globs commonly found on Santa Barbara and San Luis Obispo county beaches. Also, risks may be compounded or higher in these areas due to both chronic natural oil seeps and potential spills from oil platforms in these areas.

Between 1988 and 1999, at least six oil spills in California and one in Oregon resulted in adverse impacts to snowy plovers. One of these spills (or series of spills) occurred at Unocal's Guadalupe Oil Field in San Luis Obispo, California. During Unocal's 34-year period of operation, numerous spills of crude oil and diluent, a diesel-like product, occurred throughout the oil field. Over 190 separate spills were recorded between July 1984 and July 1990. We and other natural resource trustees have estimated that between 8 and 12 million gallons of diluent have been released into the soil, ground water, and marine environment. Between the period January 1988 and October 1998, natural resource trustees documented eight hydrocarbon releases into the marine environment at Unocal's Guadalupe Oil Field. These spills had adverse effects on plovers by contaminating their habitat and prey base. Remediation and monitoring of this contamination continue to result in the disturbance or harassment of nesting plovers. On

December 25, 1993, oil spilled from a ruptured oil transfer line into McGrath Lake, and then flowed out into the ocean. Approximately 2,000 barrels of oil were spilled, affecting 0.53 kilometer (0.33 mile) of riparian woodland area along a creek, McGrath Lake, and 11.2 kilometers (7 miles) of sandy beaches. Plover habitat and prey were contaminated with oil and wintering plovers were displaced during the cleanup activities (S. Henry *in litt.* 1998). In Washington, the 1988 Nestucca oil spill and the 1991 Tenyo Maru oil spill may also have affected snowy plovers.

Between 1996 to 1998, three oil spills in snowy plover habitat on National Park Service lands along the California coast resulted in oiled plovers. Affected areas were Ocean Beach, San Francisco, and Point Reyes National Seashore (on two separate occasions between 1997 and 1998). Snowy plovers were found oiled on Ocean Beach in November 1996. Staff of the Point Reyes Bird Observatory and the National Park Service trapped and banded eight of the birds, and there were two additional banded birds in the area. Oil was observed on the plumage or feet of all but one of these banded birds. Point Reyes Bird Observatory staff compared the survival of the birds from the oiled location to those from adjacent areas not affected by spilled oil through January 1997. There was no difference in the survival rate between the two groups of birds. However, the two Ocean Beach birds with the most oil on their plumage were the only two birds from Ocean Beach that disappeared prior to the end of January 1997. They were not seen again and presumably died (Point Reyes Bird Observatory unpublished data). In November 1997, at least 22 snowy plovers were observed at Limantour Estero, Marin County, with oil on their plumage during a spill that also affected other species of birds. Two of the oiled snowy plovers were banded. Neither apparently survived the winter (Point Reyes Bird Observatory unpublished data).

In September 1997, an oil spill caused by the rupture of a sub-sea pipeline occurred in Santa Barbara County near Pedernales Point, resulting in oiled snowy plovers. After this spill, Persons and Applegate (1997) observed lightly- to moderately-oiled snowy plovers at Surf Beach, Vandenberg Air Force Base. A sick plover was seen with a glob of heavy crude oil on its upper mandible. The authors expressed concern that had this spill occurred during the plover breeding

season, both the oil and cleanup effort would have had severe adverse effects on plover nests and chicks.

On February 4, 1999, the New Carissa, a 195-meter (639-foot) freighter ship designed to carry wood chips, went aground about 5 kilometers (3.1 miles) north of the North Jetty of Coos Bay, Oregon. The New Carissa grounded in shallow water a few hundred yards off lands managed by the U.S. Bureau of Land Management on the North Spit of Coos Bay. Attempts to burn fuel oil present on board the New Carissa resulted in the vessel being fractured into two pieces. On March 2, 1999, the 134-meter (440-foot) bow section of the ship was pulled away from the North Spit, with the intent of dumping it at sea. It broke free of the tow vessel later that day and landed on the beach at Governor Patterson Memorial State Park on March 3, 1999. This location was near Waldport, Oregon, about 129 kilometers (80 miles) north of the spot where the vessel first became grounded.

On March 8, the bow section of the New Carissa was successfully pulled off the beach at Governor Patterson Memorial State Park and taken out to sea where it was sunk on March 11, 1999, about 515 kilometers (320 miles) off the Oregon coast. The 61-meter (200-foot) stern section of the New Carissa is still present, just offshore of the North Spit of Coos Bay. Oil has leaked from the stern section on repeated occasions since the sinking of the bow section and resulted in a major operation between the ship's representatives and the U.S. Coast Guard to remove oil from it.

The U.S. Coast Guard has estimated that about 265,000 liters (70,000 gallons) of oil were released into marine waters during the Coos Bay phase of the New Carissa incident. Additionally, they estimated that another 7,600 liters (2,000 gallons) were released into the marine environment during the Waldport phase of the grounding event.

Many species of birds, including the snowy plover, were soiled with oil as a result of the incident, and there were numerous mortalities. It is estimated that at least 40 to 50 snowy plovers were oiled during the incident, representing about 50 percent or more of the Oregon wintering population. One snowy plover was

found dead with oil on it, and another two that had been seen during the incident with heavy oiling, were never seen again.

d. Contaminants

Because snowy plovers are primarily insectivorous, feeding both on aquatic and terrestrial insects, the bioaccumulation of environmental contaminants on their nesting and wintering grounds may adversely affect their health and reproduction (Powell and Hothem 1997). Organochlorines have been known to cause reduced avian egg production, aberrant incubation behavior, delayed ovulation, embryotoxicosis, and mortality of chicks and adults (Blus 1982). Selenium has caused decreased hatchability of avian eggs, developmental abnormalities, altered nesting behavior, and embryotoxicosis in birds in field and laboratory studies (Ohlendorf *et al.* 1986, Heintz *et al.* 1987). Mercury is known to cause decreased hatchability of avian eggs (Connors *et al.* 1975). Boron has been shown to reduce hatchability of waterfowl eggs in laboratory experiments; arsenic may also adversely affect avian reproduction (Hothem and Welsh 1994).

Powell and Hothem (1997) analyzed 23 snowy plover eggs collected in southern California from 1994 to 1996 for metals and trace elements, and 20 eggs for organochlorine pesticides and metabolites. All eggs were either abandoned or failed to hatch. They were collected from five sites: Camp Pendleton Marine Corps Base, Batiquitos Lagoon, Naval Air Base Coronado, Sweetwater Marsh National Wildlife Refuge, and Tijuana Estuary. Organochlorines including dieldrin, o,p'-DDD, o,p'-DDE, o,p'-DDT, p,p'-DDD, p,p'-DDE, p,p'-DDT, oxychlorane, and trans-nonachlor were found above the detection limits in snowy plover eggs. Median DDE and PCB concentrations were less than those normally associated with deformities or other detrimental effects on birds. Twelve metals and trace elements (As, B, Cr, Cu, Fe, Hg, Mg, Mn, Ni, Se, Sr, and Zn) were detected in at least 90 percent of the samples, but generally at background levels. Mean concentrations of all contaminants were below those that would adversely affect reproduction.

Ten snowy plover eggs collected near Lake Abert, Oregon, were analyzed for organochlorine insecticides and total polychlorinated biphenyls. Concentrations

were less than 0.05 parts per million (level of detection) for all analyses except DDE, which was found in seven of the eggs at concentrations ranging from 0.05 to 0.19 parts per million, wet weight (U.S. Fish and Wildlife Service unpublished data). These DDE concentrations are less than those associated with poor reproductive success, including eggshell thinning, in other avian species (T. Buerger *in litt.* 1998).

e. Litter, Garbage, and Debris

Placement of litter, garbage, and debris in the coastal ecosystem can result in direct harm to snowy plovers and degradation of their habitats. Litter and garbage feed predators and encourage their habitation at higher levels than would otherwise occur along the coast, making predators a greater threat to plovers.

Marine debris and contaminated materials on the beach also adversely affect snowy plovers. Marine debris is attributed to both ocean and shoreline sources. Ocean sources of marine debris and contamination include fishing boats, ships, and cruise lines. Cruise line debris may include small plastic shampoo, conditioner, hand lotion, and shoe polish containers, plastic cups, and balloons (Center for Marine Conservation 1995). Shoreline debris is usually from land sources. Plovers may become entangled in discarded fishing line, fishing nets, six-pack rings, and other materials on the beach. Containers of contaminated materials (e.g., motor oil, cleaning fluid, and syringes) can introduce toxic chemicals to the beach. The National Marine Debris Monitoring Program, headed by the U.S. Environmental Protection Agency, was established to clean and track sources of marine debris in coastal areas. This monitoring program, while beneficial to snowy plovers in the long-term, could potentially adversely affect nesting plovers since the program is conducted year-round.

f. Water Quality and Urban Run-off

Many coastal beaches used as habitat by snowy plovers contain channelized streams or outfalls receiving run-off from urban, industrial, and agricultural areas. Nonpoint sources of water pollution (including hydrocarbons, heavy metals, and household chemicals) could end up at coastal beaches used as plover foraging

areas. In 1995, three dead male plovers (all banded and local breeders) were found in an area containing local outfalls, including an outfall connected to a sewage treatment plant at Monterey Bay. By the beginning of the next breeding season, it was discovered that another male snowy plover from this area disappeared and possibly died. One of the birds was analyzed through necropsy and found to have an enlarged liver, but it could not be determined whether there was a relationship between the mortality and the outfall (Point Reyes Bird Observatory unpublished data).

g. Management for Other Special Status Species

Snowy plover chicks die when they become entrapped within the mesh of some fences used to enclose California least tern colonies (Powell and Collier 1995). These fences also impede plover chicks from following their parents to feeding areas. Chicks may die of exposure and starvation if they cannot join their parents because of separations caused by least tern fencing. During the 1995 breeding season, six instances of chick mortality were attributed to entanglement in least tern chick fencing at Camp Pendleton, and three other chicks were found dead just outside the fenced tern colonies (Powell *et al.* 1995). During the 1996 breeding season, Powell *et al.* (1996) observed a plover family that was apparently caught in the corridor used by amphibious-tracked and other four-wheel drive vehicles at Camp Pendleton while attempting to get to a pond approximately 300 meters (984 feet) from their nesting area. Because of the small mesh size, they were unable to get through the fencing erected to keep least tern chicks from wandering into vehicular traffic, and were seen running back and forth across the corridor as vehicles drove through.

At the Channel Islands and other lands managed by the National Park Service, a decline of snowy plovers may be caused by habitat loss resulting from the large increase in numbers of marine mammals on beaches (U.S. Fish and Wildlife Service *in litt.* 1995). Breeding pinnipeds, including northern elephant seals (*Mirounga angustirostris*) and California sea lions (*Zalophus californianus*) at San Miguel Island, have occupied snowy plover nesting habitat. Beach-cast dead whales have, on occasion, posed threats to nesting snowy plovers. At Point Reyes beaches, large, whole carcasses have washed ashore and other agencies such as

the National Marine Fisheries Service have sought to collect them for scientific purposes. They also attract people who are curious about whales. These activities could potentially cause direct mortality and disturbance to snowy plovers. In addition, mammal carcasses attract scavengers such as gulls and ravens that are potential predators to snowy plovers.

E. IMPLICATIONS FOR THE COASTAL BEACH-DUNE ECOSYSTEM

The western snowy plover lives in an ecosystem that has been significantly degraded. Environmental stressors (i.e., development, human recreation, water quality degradation, etc.) have adversely affected the biological diversity of the coastal dune ecosystem. Many of the characteristics that attract people to coastal areas make these areas prime habitat for fish and wildlife resources. Although they comprise less than 10 percent of the Nation, coastal ecosystems are home to over one-third of the United States human population, nearly two-thirds of the Nation's fisheries, half of the migratory songbirds, and one-third of our wetlands and wintering waterfowl (U.S. Fish and Wildlife Service 1995*a*). The coasts also provide habitat for 45 percent of all threatened and endangered species, including three-fourths of the federally-listed birds and mammals (U.S. Fish and Wildlife Service 1995*a*). Proper stewardship of this unique ecosystem is needed to maintain its ecological integrity while meeting its human demands.

1. Description of Coastal Beach-Dune Ecosystem

The coastal beach-dune ecosystem may include several features such as beaches, foredunes, deflation plains, blow-outs, and reardunes. The beach includes the expanse of sandy substrate between the tide line and the foredune or, in the absence of a foredune, to the furthest inland reach of storm waves. Beach steepness, height, and width are affected by wave height, tidal range, sand grain size, and sand supply. The beach has high exposure to salt spray and sand blast and contains a shifting, sandy substrate with low water-holding capacity and low organic matter content. Dunes include sandy, open habitat, extending from the foredune to typically inland vegetation on stabilized substrate. Major differences occur between beach and dune in salt spray, soil salinity, and air and soil temperatures (Barbour and Major 1990).

Coastal dunes generally consist of three primary zones (Powell 1981). The foredunes are the line of dunes paralleling the beach behind the high tide line. Foredunes are characterized by unstabilized sand and a simple community of low-growing native dune plant species, such as American dunegrass (*Leymus mollis*). Foredunes also support a rich community of sand-burrowing insects (Powell 1981). Behind the foredunes is the deflation plain, which is at or near the water table and is characterized by a mixture of water tolerant plants and dune species. Deflation plains are also called dune hollows and can be invaded by hydrophilic (having a strong affinity for water) trees, shrubs, or herbs (e.g., species of *Carex*, *Juncus*, *Salix*, *Scirpus*) (Barbour and Major 1990). The inner zone of coastal dunes consists of stabilized dunes, which are dominated by woody perennial plants (Powell 1981). Beach flora can also colonize inland dune areas, where the sand is actively moving (Barbour and Major 1990).

Barren dunes, receiving sand from the beach and losing it to wind erosion, are mobile. Older, more inland dunes are stabilized by a nearly continuous plant cover; these dunes are referred to as stable dunes or fixed dunes. Localized openings in the plant cover, which permit wind erosion, are called blowouts, but they are not deep enough to allow invasion by mesophytes (plants growing in moderately moist environments). The innermost ridge of sand is generally high and is called a precipitation ridge; sand is blown over the ridge and down the slipface, continuing the process of dune advance (Barbour and Major 1990). The conditions necessary for dune growth at the coast are partly climatic, but more important is the occurrence of strong onshore winds, abundant sand supply, and vegetation that traps sand. Low, near-shore slopes with a large tidal range providing wide expanses of sand that dries at low tide are ideal for dune growth (Pethick 1984).

Very few coastal dunes are “natural,” because they have been extensively altered over time by humans for agriculture, mineral extraction, military training, and both active and passive recreation (Carter 1988). Before the introduction of beachgrass foredunes were low and rose gradually, and a large number of native species shared this habitat. They were composed of a series of dunes alternating with swales oriented perpendicular to the coast and aligned with prevailing

onshore winds. Since the introduction of European beachgrass, most systems have been replaced by a steep foredune that gives way inland to a series of dunes and swales oriented parallel to the coast (Barbour and Major 1990).

Snowy plovers use the beach and mobile dunes as nesting habitat. Other habitat features that occur within or adjacent to the coastal beach-dune ecosystem, and serve as important foraging habitat for the western snowy plover, include river, stream, and creek mouths, river bars, lagoons, and tidal and brackish-water wetlands.

2. Sensitive Species of the Coastal Beach-Dune Ecosystem

Along with the western snowy plover, many other sensitive species inhabit the coastal beach-dune ecosystem and adjacent habitats. Appendix E contains a list of, and brief species accounts for, sensitive species associated with this ecosystem and adjacent habitats. These fish and wildlife species are recognized by the U.S. Fish and Wildlife Service as endangered, threatened, candidate species, or species of concern. This list includes a number of sensitive species recognized by the states of California, Oregon, and Washington. This appendix also describes several marine mammals associated with the coastal beach-dune ecosystem and protected under the Marine Mammal Protection Act of 1972 (16 U.S.C. 1361-1407), as amended.

Some of these sensitive species have many threats in common with the western snowy plover. Habitat loss and degradation from shoreline development and beach stabilization, invasion of exotic species, and crushing by off-road vehicles are cited as major factors contributing to the status and listing of these species. In addition to the snowy plover, European beachgrass is a current or potential threat to six federally-listed endangered plants that occur in coastal dunes of California: beach layia (*Layia carnosa*), Howell's spineflower (*Chorizanthe howellii*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), Menzies' wallflower (*Erysimum menziesii*), Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*), and Tidestrom's lupine (*Lupinus tidestromii*) (Pickart 1997). European beachgrass is also a current and potential threat to native and sensitive plants in Washington and

Oregon, including the pink sand-verbena (*Abronia umbellata* ssp. *breviflora*), which is classified as endangered in the State of Oregon. Equestrian use has also been identified as a threat to several endangered plant species, including the endangered Howell's spineflower, Menzies' wallflower, Monterey gilia, and the coastal dunes milk vetch (*Astragalus tener* var. *titi*). Off-road vehicles are cited as threats to several sensitive plant and animal species, including the endangered beach layia, Menzies' wallflower, Monterey gilia, Tidestrom's lupine, Hoffman's slender-flowered gilia (*Gilia tenuiflora* var. *hoffmanii*), and Smith's blue butterfly (*Euphilotes enoptes smithi*); the federally-proposed endangered La Graciosa thistle (*Cirsium longholepis*), and the following species considered to be of Federal concern: beach spectacle pod (*Dithyrea maritima*) and Morro blue butterfly (*Icaricia icarioides morroensis*).

The precarious status of these species is a symptom of a highly stressed ecosystem. Remedial efforts aimed at restoration of the natural processes that maintain this ecosystem, rather than single-species "fixes," are likely to have the greatest and most successful long-term benefits. Important components of ecologically-sound coastal beach-dune ecosystem management include (1) removal of exotic, invasive vegetation; (2) management of human recreation to prevent or minimize adverse impacts on dune formation, vegetation, invertebrate and vertebrate fauna; and (3) efforts to counter the effects of human-induced changes in the types, distribution, numbers, and activity patterns of predators. Implementation of more ecosystem-oriented approaches to snowy plover protection would provide important benefits to other sensitive species within the coastal dune ecosystem and merits serious consideration.

Snowy plover recovery efforts implemented to date (e.g., removal of European beachgrass) support the natural functions of the coastal dune ecosystem. Furthermore, many protection efforts for snowy plovers should benefit other sensitive beach species, such as California least terns and vice versa. Many of the same predators that take snowy plover eggs also prey on California least tern eggs. The relatively low rate of predation of snowy plover nests in San Diego County has been attributed to the predator control program by the U.S. Department of Agriculture, Wildlife Services Branch, for the management of California least terns (Powell *et al.* 1995). Opportunities may also exist for reestablishment of

special status plant species that occur in coastal dunes, including Menzies' wallflower, beach spectacle pod, Tidestrom's lupine, beach layia, and pink sand verbena.

At the same time, however, conflicts have occurred in management of snowy plovers and California least terns in southern California. These conflicts include losses of snowy plover chicks due to entanglement in the mesh of California least tern fencing. Efforts are needed to better coordinate and implement management measures to meet the habitat needs of both snowy plovers and California least terns. Potential conflicts also exist between native dune restoration and snowy plover habitat. Revegetation efforts could result in too much cover, thereby reducing the amount of suitable breeding habitat available for plovers.

Conflicting habitat requirements for snowy plovers and pinnipeds have also occurred on lands where marine mammals haul out or breed on beaches that would otherwise be suitable for nesting plovers. Where this conflict occurs, it may be necessary to discourage use by breeding pinnipeds during the plover nesting season.

Although some management measures may benefit a broad array of sensitive species within the coastal dune ecosystem (i.e., control of *Ammophila*, access restrictions, and integrated predator management programs), some single-species protection measures for the snowy plover, such as exclosures, are needed. Exclosures are currently the most effective and efficient way to protect nests against heavy recreational use and prolific, well-established predators, especially where reductions in predator numbers would otherwise be temporary and difficult to achieve.

F. CONSERVATION EFFORTS

Snowy plover recovery efforts have accelerated since this species was federally listed as a threatened species in 1993. Current breeding and wintering site protection efforts are documented in Appendix C (Summary of Current and Additional Needed Management Activities). The most common management strategies include protection of nests with predator exclosures; signing and

symbolic fencing of nesting areas; restrictions on motorized vehicles in the vicinity of plover nests and broods; restrictions on dogs (even though enforcement of dogs on-leash has been problematic); closure of nesting areas to the public; and public information and outreach. These strategies represent effective means of improving snowy plover reproductive success in return for efforts expended.

1. Conservation Planning on Federal and State Lands

The direction of land management on Federal lands is often outlined in management plans or agency regulations that provide objectives and guidelines for snowy plovers. These plans include the Oregon Dunes National Recreation Area Management Plan (U.S. Department of Agriculture, Forest Service, 1994), the Coos Bay Shorelands Final Management Plan (U.S. Department of the Interior, U.S. Bureau of Land Management 1995a), The New River Area of Critical Concern Management Plan (U.S. Department of the Interior, U.S. Bureau of Land Management 1995b), the Draft Snowy Plover Management Plan for Ocean Beach, Golden Gate National Recreation Area (Hatch 1997), and the Draft Western Snowy Plover Management Plan for the Point Reyes National Seashore (White and Allen in prep.).

Wildlife protection, especially the preservation, restoration, and enhancement of threatened and endangered species and migratory birds, is the primary goal of national wildlife refuges (U.S. Fish and Wildlife Service 1982). Snowy plover habitat on national wildlife refuges has been accorded intensive protection, including (1) integrated predator management and (2) closures during the nesting season where appropriate, to minimize adverse effects of disturbance. Consistent with requirements of the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) and Refuge Recreation Act of 1962, as amended (16 U.S.C. 460k-460k-4) regarding compatibility of refuge activities, plover nesting areas within some national wildlife refuges are closed to public use during the breeding season.

The Washington State recovery plan for the snowy plover recommends strategies to recover this species, including protection of the population, evaluation, and

management of habitat, and initiation of research and education programs (Washington Department of Fish and Wildlife 1995).

The State of Oregon's Conservation Program for the coastal population of the western snowy plover, required by the Oregon Endangered Species Act and adopted by the Oregon Fish and Wildlife Commission (Oregon Revised Statutes 496.171 through 496.192), requires a variety of actions to protect this subspecies. These actions include: (a) protecting all existing snowy plover sites from negative impacts; (b) monitoring impacts and responding on damaging activities (e.g., urban development and recreation disturbance) to minimize or eliminate their effects to snowy plovers; (c) maintaining a long-term monitoring program to track numbers, distribution, and nesting success; (d) habitat management, such as local control of European beachgrass and maintaining predator protection measures to maximize breeding success for as long as deemed necessary; (e) conducting additional research to maintain and recover snowy plovers; and (f) enhancing information availability, education, and awareness of western snowy plovers and their requirements for survival and recovery (Oregon Department of Fish and Wildlife 1994).

The California Public Resources Code (Section 5019.71) allows designation of natural preserves, the most protective designation given to a part of any State park system unit. The purpose of natural preserves is to preserve such features as rare or endangered plant and animal species and their supporting ecosystems, and representative examples of plant or animal communities existing in California prior to the impact of civilization. The Pajaro Rivermouth Natural Preserve, Wilder Creek Natural Preserve, and Salinas Rivermouth Natural Preserve were designated by the California State Park and Recreation Commission in recognition of the need to protect snowy plovers. In addition, Section 5019.62 of the California Resources Code allows the designation of State seashores. The purpose for designation of State seashores is to "preserve outstanding natural, scenic, cultural, ecological, and recreational values of the California coastline as an ecological region and to make possible the enjoyment of coastline and related recreational activities which are consistent with the preservation of the principal values and which contribute to the public enjoyment, appreciation, and understanding of those values." Within the state of California, the following State

seashores that contain snowy plover habitats have been established: Del Norte State Seashore; Clem Miller State Seashore; Sonoma Coast State Seashore; Año Nuevo State Seashore; Monterey Bay State Seashore; San Luis Obispo State Seashore; Point Mugu State Seashore; Capistrano Coast State Seashore; and San Diego Coast State Seashore. Under the California Public Resources Code, the California Department of Parks and Recreation has the authority to identify additional lands appropriate for inclusion in State seashores and recommend land acquisition for these purposes.

Special management actions for snowy plovers are conducted within the portions of State seashores that are owned by the California Department of Parks and Recreation. An example is the Monterey State Seashore, where the California Department of Parks and Recreation has conducted intensive management activities for snowy plovers since 1991. Strategies include resource management, interpretation, law enforcement, and park operations. Resource management actions include monitoring, predator trapping, and use of exclosures, symbolic fences, and signage. Interpretative efforts include informational signage at nesting areas, information brochures, small handout cards with photographs and information on snowy plovers, and several annual public outreach programs (e.g., slide programs and field trips), actions to engage community support for the snowy plover guardian program (i.e., recruitment, training, and scheduling for volunteer presence in sensitive habitat). Enforcement actions include verbal warnings, written warnings, citations, and arrest as necessary. Key enforcement concerns include dogs off-leash and off-road vehicles, which are prohibited on all beaches. Operational management includes a permit process that screens special events to avoid the nesting season in sensitive areas, and regulation of recreational use of beaches to avoid sensitive areas (i.e., kite flying, hang gliding, fishing, etc.). Other management actions on California Department of Parks and Recreation property within some other State seashores are shown in Appendix C.

2. Conservation Efforts on Federal And State Lands

a. Exclosures, Symbolic Fencing, and Signs

Since 1991, one of the primary techniques to protect nesting snowy plovers has been the use of exclosures (see Appendix F). Exclosures are small circular, square, or triangular metal fences that can be quickly assembled and are designed to keep predators out of nests (Figure 8).



Figure 8. Erecting snowy plover exclosure (photo by Sue Powell, with permission).

After only 1 year of exclosure use on Point Reyes National Seashore beaches, the breeding population doubled resulting in 25 snowy plovers breeding during the 1997 season (White and Hickey 1997). Use of nest exclosures at Coos Bay North Spit in Oregon (OR-15 in Appendix B) during the 1991 breeding season resulted in 69 percent nesting success, compared to only 9 percent nesting success for unprotected nests (Stern *et al.* 1991*b*). During the 1992 breeding season, nest success at southern Oregon locations was significantly higher (84 percent versus 5 percent) for nests protected with exclosures compared to unprotected nests (Craig *et al.* 1992). At some locations in Oregon and California, exclosures are designed with tops consisting of parallel lengths of nylon seine lines spaced approximately 15 centimeters (6 inches) apart, designed to discourage entry by avian predators.

Although exclosures are contributing to improved productivity and population increases in some portions of the snowy plover's Pacific coast range, problems have been noted in some localities. Potential risks associated with exclosures include vandalism or disturbance of the birds by curiosity seekers and use of exclosures as predator perches. Also, predator exclosures may be impractical where snowy plovers nest within California least tern colonies.

Symbolic fencing is also used to protect snowy plover nests, eggs, and chicks. This fencing consists of one or two strands of light-weight string or cable, tied between posts to delineate areas where pedestrians and vehicles should not enter (Figure 9).

It is placed around areas where there are nests or unfledged chicks, and is intended to prevent accidental crushing of eggs, flushing of incubating adults, and to provide an area where chicks can rest and seek shelter when large numbers of people are on the beach.

Directional signs (regarding closed areas, nesting sites, etc.) are also used within snowy plover habitats and near protective fencing to alert the public of the sensitivity of snowy plover nesting and wintering areas.



Figure 9. Symbolic fencing on beach at Monterey Bay, California (photo by Ruth Pratt, with permission).

b. Law Enforcement

Management agencies recognize that law enforcement is needed for protection measures to be effective. Though a majority of beach visitors respect restrictions to protect snowy plovers, there will always be a certain percentage who do not. Enforcement of plover area restrictions shows that managers are serious about compliance. In Oregon, biologists have established a working relationship with a variety of law enforcement agencies who have jurisdiction in snowy plover habitat. Their goal is to increase awareness, gain advice, increase communication and coordination to alleviate jurisdictional conflicts, and train officers on how to minimize disturbance while patrolling snowy plover habitat. Conflicting priorities and personnel turnover require perseverance to maintain effective working relationships across law enforcement jurisdictions.

c. Predation Control

At the south spoils area of Coos Bay, North Spit, the U.S. Bureau of Land Management, U.S. Army Corps of Engineers, and Oregon Department of Fish and Wildlife have fenced 8 hectares (20 acres) of snowy plover nesting habitat. This 5-centimeter by 5-centimeter (2-inch by 2-inch) square wire mesh fence was installed to exclude mammalian predators, especially skunks, and to discourage human disturbance from off-highway vehicle use. The original fence that was constructed in 1991 suffered from the effects of weathering with areas of rust and numerous holes. It continued to deter vehicles but was no longer an effective barrier to predators. In February and March 1998, the U.S. Army Corps of Engineers and U.S. Bureau of Land Management jointly constructed a new fence. The new fence matched the design of the 1991 fence (5-centimeter by 5-centimeter (2-inch by 2-inch) mesh fence material with an effective fence height of about 1.2 meters (4 feet) after burial of the bottom). However, the new fence has increased the protected area from 8 hectares (20 acres) to 28.4 hectares (71 acres), and includes both the south spoils area and the 1994 Habitat Restoration Area (E.Y. Zielinski and R.W. Williams *in litt.* 1999).

At the Don Edwards San Francisco Bay National Wildlife Refuge, fences are constructed across salt pond levees to block access by predators (J. Albertson *in litt.* 1999).

Exclosures are much more effective when used in conjunction with an integrated predator management program that includes removal of predators. Otherwise, they may promote better hatching success, but not fledging success if predators such as red fox focus on adults protecting the nest or newly-hatched chicks that leave the exclosure to feed. These measures are also much more effective where combined with other access restrictions to increase survival of clutches and broods.

Lethal and nonlethal means of predator control have been used with mixed success to protect snowy plovers on Pacific Coast beaches. Trapping the nonnative red fox has been credited with substantially increased plover abundance and productivity at Salinas River National Wildlife Refuge (E. Fernandez pers. comm. 1998). At the Don Edwards San Francisco Bay National Wildlife Refuge, losses of snowy plover nests from predation by red foxes have decreased as a result of the use of exclosures combined with predator management (J. Albertson *in litt.* 1999).

The U.S. Air Force has used electric fencing around the California least tern colony at Purisima Point, Vandenberg Air Force Base, California, where snowy plovers also nest and winter. The electrified portion of this fence is approximately 273 meters (300 yards) long and 1.2 meters (4 feet) high. The electric fence contains six strands of electrified wire placed approximately 10.2 centimeters (4 inches) apart. This fence is generally effective at keeping out mammalian predators of California least terns. It has also incidentally protected a small population of snowy plovers by deterring plover predators. Because some coyotes are still able to get through the fence, supplemental predator control of coyotes is still necessary (N. Read pers. comm. 1999).

Aversive techniques have also been used with some success on predators of piping plovers. Electric fencing around nest exclosures has been successfully used on “smart” predators, such as foxes, that have figured out how to dig under,

climb, or jump over exclosures to reach piping plover eggs. The Maine Audubon Society has used a single strand of electrified wire around an exclosed nest where foxes were present. The single-strand electric wire, which is placed approximately 23 centimeters (9 inches) from the bottom of the exclosure, gives the fox an electric shock. The fox becomes conditioned to the associated shock with the exclosure and, as a result, avoids the exclosure. Fox tracks found at one of these electrically-wired nest exclosures indicated that the fox ran away from the exclosure. Subsequently, the exclosed and also the unprotected nests at the site were not disturbed (A. Hecht *in litt.* 1998).

Proposals have been developed to test a conditioned taste aversion technique on predators of piping plovers (i.e., red fox) by using quail eggs treated with the chemical emetine (McIvor 1991). The purpose of this technique is to condition foxes to avoid eating plover eggs, expecting that if foxes eat treated quail eggs prior to the nesting season and become sick, they might develop a conditioned aversion to eating plover eggs. This technique requires that the predator consumes the needed dose that will produce short-term illness but no mortality. Implementation of proposals to test conditioned taste aversion techniques on predators of piping plovers on the east coast have not been implemented due to difficulties obtaining permission to field test emetine (A. Hecht pers. comm. 1996).

Avery *et al.* (1995) found that deployment of quail eggs treated with the chemical methiocarb might be a useful means of reducing predation of California least terns by ravens and crows. In this study, conducted from April to June 1992 at Camp Pendleton, California, methiocarb-treated eggs were used under an experimental pesticide use permit issued by the California Department of Pesticide Regulation. The authors found this technique was potentially useful for reducing nest predation, provided the eggs are placed at the target site 2 to 3 weeks prior to egg-laying by terns, and the territorial ravens exposed to treated eggs near the tern colonies are allowed to remain to defend the area from untrained raven intruders. However, one raven was found dead and necropsy substantiated that it obtained a lethal dose of methiocarb by ingesting two entire treated eggs. Because some ravens may swallow whole treated eggs, there is potential for inadvertent mortality, which would defeat the purpose of this technique.

Care must be taken to design and conduct taste aversion experiments in a way that will avoid detrimental impacts to sensitive species. In 1995, another aversive conditioning study was conducted at Camp Pendleton, California. The taste aversion experiment, conducted by the U.S. Department of Agriculture, Wildlife Services Branch, involved placing quail eggs along a transect through the California least tern colony. At least one snowy plover nest was lost to ravens at Camp Pendleton in 1995. Raven tracks were observed following the line-transect of quail eggs put out as part of the taste aversion experiment, and the tracks stopped at a plover nest located within 5 meters (16 feet) of the transect (Powell and Collier 1995).

With proper research, techniques that have been used to deter predators of other wildlife species may prove beneficial to snowy plovers. At Vandenberg Air Force Base, strategic placement of crow and gull carcasses around the perimeter of a California least tern colony has been fairly successful. Persons and Applegate (1996) reported that gulls, suspected of being predators of snowy plovers at the Purisima Beach, Vandenberg Air Force Base, left the site after gull carcasses were used as deterrents. Plovers may have benefitted from this effort incidentally (N. Read pers. comm. 1998).

d. European Beachgrass Control

Experiments to find cost-effective methods to control or eradicate European beachgrass are ongoing. Various methods have been used, including manual digging, mechanical removal, salting, burning, cutting, and use of herbicides.

Since 1993, there have been multiple projects on the North Spit of Coos Bay, Oregon, to control beachgrass on old dredged material disposal sites and to clear and maintain adjacent areas. The U.S. Bureau of Land Management has cleared over 60 hectares (150 acres) of vegetation dominated by European beachgrass, shore pine, Sitka spruce, and Scotch broom. The objective is to remove predator cover, remove encroaching beachgrass, and expand the existing habitat. The goal is to create an area for plovers to nest that is large enough to lessen possible detection of nests and chicks by predators. Many of the cleared areas were used almost immediately by nesting plovers or for brood rearing activities.

Habitat restoration work not only benefits snowy plovers, but other species as well. Wetland loss has accelerated on the North Spit as beachgrass has become better established. A project objective is to retain and enhance existing sedge wetland features present on the east part, thereby providing habitat for other shorebirds and wildlife species that will benefit from this effort. Pink sand-verbena has also been reintroduced to some of the sites.

Control methods employed at various times and places have included hand pulling, spraying of herbicide, hummock removal with front-end loaders, subsoiling with a winged subsoiler (essentially a heavy duty three-point plow), disking with a standard farm tractor and disk, burning, and saltwater irrigation. Areas containing heavy growth of European beachgrass and woody vegetation are prescribed-burned prior to using heavy equipment. Areas are leveled to allow disking for maintenance. In some areas, oyster shell hash provided by a local oyster grower has been distributed after vegetation has been removed. Effectiveness of the various control methods varies, though maintenance will always be required.

At the Coos Bay North Spit, an inmate crew from the Shutter Correctional Facility, hired by the U.S. Bureau of Land Management, hand pulled European beachgrass on approximately 6 hectares (15 acres) of the south spoil area. The 4-month project was completed with 1,700 inmate-hours of labor and required approximately 280 inmate-hours per hectare cleared (113 inmate-hours per acre). The total cost of the project was \$11,200; most of these costs covered the crew supervisor's salary and transport vehicle charges. Pitchforks seemed to be the most effective tool used; shovels tended to cut the roots and garden trowels typically broke during the work. The project revealed that sturdy hand trowels would be a valuable tool for hand pulling treatments (Oregon Department of Fish and Wildlife 1996). Another European beachgrass removal project around the south spoil areas of the Coos Bay North Spit, included burning European beachgrass, followed by scarification using a bulldozer in March 1994. By August, most of the area had resprouted; but the grass was relatively easy to remove by hand (Oregon Department of Fish and Wildlife 1996).

At the Coos Bay North Spit, eradication of European beachgrass using 91.4 centimeters (36 inches) of sprayed seawater was attempted in 1996. The saltwater application was not effective because desiccated sand layers did not allow seawater penetration to the grass's root zone. Future experimentation using wetting agents to achieve water penetration on small-scale applications could demonstrate potential applicability of this technique (G. Dorsey pers. comm. 1997).

In Oregon, the New River Spit is another key nesting area for the snowy plover that is managed by the U.S. Bureau of Land Management. In October 1998, using a front-end loader equipped with a 2.7 cubic meter (3.5 cubic yard) bucket, the U.S. Bureau of Land Management opened up and widened the front of four overwashes, removing much of the European beachgrass and built-up sand within the overwash with the intention of allowing ocean wave action/surge to enter the overwash areas during winter storms, thus scouring out some of the remaining grass, sand, and debris that were not removed. Also, because the overwashes are adjacent to one another, and there is some connection between them, water and sand movement may occur from one overwash into the next, possibly creating additional pockets of suitable habitat for nesting snowy plovers, and for movement of plover broods. Operation of the loader created approximately 0.4 hectare (1 acre) of open sand habitat in each of the four overwashes, for a total of 1.6 hectares (4 acres). The use of a front-end loader has its limitations, such as with the removal of some of the taller hummocks. A model D-6/7 or 8 Caterpillar would be more effective in taking hummocks down, and with a bucket attachment, larger loads could possibly be removed more quickly and deposited in the beach surf zone. Both machines have the ability, through back-blading, to smooth and recontour the work area. The total cost of the project was approximately \$10,000 (E.Y. Zielinski and R.W. Williams *in litt.* 1999).

At the Oregon Dunes National Recreation Area, the U.S. Forest Service employs a combination of mechanical, manual, and herbicide treatments to control European beachgrass. The National Recreation Area contains about 2,400 hectares (6,000 acres) of European beachgrass and now has few remaining examples of intact native plant communities (Pickart 1997). Heavy equipment is used in combination with manual and chemical control. Mechanical treatment consists of

scalping off the top 1 meter (3 feet) of beachgrass and then burying it in an adjacent trench with a minimum covering of 1 meter (3 feet) of sand. Moderate to heavy resprouting occurs with this method, requiring manual or chemical follow-up treatment. Other mechanical treatments have consisted of placement of dredged material on the beachgrass and scalping the top half of foredunes to remove beachgrass and allow for inland sand movement and tidal action to maintain open dunes (K. Palermo *in litt.* 1998b).

At the Oregon Dunes National Recreation Area, herbicide treatments have been conducted as a primary control method and as follow-up to mechanical control. In recent years, from 2 to 26 hectares (5 to 65 acres) of beachgrass were sprayed with an herbicide treatment of 8 percent Rodeo and nonionic surfactant (spray-to-wet) at three locations. Employees found that a follow-up application within 2 weeks of the first application was critical to obtain optimum coverage and initial die-off rates (90 percent). Additionally, herbicide treatments were most effective when conducted consecutively over 2 to 3 years depending on density. Beachgrass control at the Oregon Dunes is still considered experimental. Preliminary results suggest that maintenance will always be necessary (K. Palermo *in litt.* 1998b).

Work at Lanphere-Christensen Dune Preserve in Humboldt County, California, showed that hand pulling can eliminate European beachgrass, but 3 years of multiple maintenance treatments were required (Pickart and Sawyer 1998). Use of heavy equipment (e.g., "V" ripper) and herbicides may be more cost-effective; however, resprouting of the grass occurs, necessitating follow-up, manual pulling for long-term beachgrass removal (A. Pickart pers. comm. 1997).

The effective strategy used by the California Department of Parks and Recreation to remove beachgrass at Marina Dunes and Salinas River State Beaches, Monterey Bay, included multiple herbicide applications of 10 percent Round-Up. Approximately 25 patches of beachgrass covering a total approximately 0.5 hectare (1.3 acres) have been treated along a 6.4-kilometer (4-mile) section of beach. Each patch of beachgrass was sprayed every 3 months over a 3-year period. All treated sites were marked so that they could be easily located and monitored for regrowth and spread. Current plans include beachgrass removal on

approximately 30 hectares (75 acres) at Zmudowski State Beach at the Pajaro River mouth (D. Dixon *in litt.* 1998).

Pickart (1997) suggested that chemical treatment of European beachgrass is likely to be the most cost-effective method used to date. Herbicides that have been used for this purpose are glyphosates (trade names Rodeo and Round-Up). The most effective period for herbicide treatment of beachgrass is during its flowering stage (Wiedemann 1987); plants should be treated during periods of active growth (Pickart 1997). However, potential adverse biological impacts to other native plants and animals must be considered when using herbicides, and selective spraying may be difficult in some areas. Chemical treatment in active snowy plover nesting areas may need to be limited to the period outside the breeding season in certain areas to avoid disturbing nesting plovers.

Additional management options for beach and dune erosion control are needed. Beachgrass continues to be used because it has been tried successfully in the past, nursery stock is available, and field planting technology is well known. However, negative aspects of its monoculture are recognized. Proper planting and management of a mixture of native vegetation, together with the provision of walkways for pedestrian traffic and the elimination of horse traffic, cattle grazing, and off-road vehicles, may result in stabilization every bit as effective as beachgrass, yet there has been minimal experimentation with this technique (Barbour and Major 1990).

e. Off-Road Vehicle Restrictions and Management

Management strategies to reduce off-road and other vehicle impacts have been implemented at some snowy plover breeding sites. At Pismo/Oceano Dunes State Vehicular Recreation Area, California, management strategies include fenced-off nesting areas; placement of exclosures around nests; restrictions on vehicle speed and access areas; and requirements that car campers remove all trash. At Pismo/Oceano Dunes State Vehicle Recreation Area, a management plan is being developed as an interim measure by the California Department of Parks and Recreation, Off-Road Vehicle Division, to address what effects current management measures have on hatching and fledging rates, as well as recruitment

into the snowy plover population (D. Noda *in litt.* 1996). However, as a result of a violation under section 9 of the Endangered Species Act involving a portion of the park not covered by the Fish and Wildlife Service biological opinion and the required habitat management plan, the Off-Road Vehicle Division of the California Department of Parks and Recreation is now funding the development of a habitat conservation plan (in anticipation of applying for a section 10(a)(1)(B) permit under the Endangered Species Act) for the Pismo/Oceano Dunes State Vehicular Recreation Area and other State parks within the San Luis Obispo District of the California Department of Parks and Recreation. We hope that the San Simeon District will also seek coverage under this habitat conservation plan.

The conservation issues for western snowy plovers and California least terns at the Pismo/Oceano Dunes State Vehicular Recreation Area are directing the development of the habitat conservation plan, but it is likely that other species will be covered. The California Department of Parks and Recreation is currently considering what species they want covered under the habitat conservation plan. This plan will evaluate the effects that recreation and park management activities are having on the covered species. Successful development of this Plan will provide a template for other districts of the California Department of Parks and Recreation to follow for coastal conservation issues on State parks throughout California.

On the Don Edwards San Francisco Bay National Wildlife Refuge, part of the main access road (Marshlands Road) is closed to motorized vehicles from April 1 to August 31, to protect snowy plovers nesting near the roadway. Highway traffic cones and ribbons are installed to discourage vehicle access to nesting areas on roads and levees (J. Albertson *in litt.* 1999).

In 1995, after the Oregon Dunes National Recreation Area completed its management plan, the U.S. Forest Service petitioned the Oregon Parks and Recreation Department to close several kilometers of beach that had been open to vehicles. Resulting closures reduced conflicts between off-highway vehicles and nonmotorized recreationists, snowy plovers, and other wildlife (E.Y. Zielinski and R.W. Williams *in litt.* 1999).

On some beaches at Willapa National Wildlife Refuge, where off-road vehicles are prohibited, violations still occur. During the mid-March to mid-September snowy plover nesting season, off-road vehicles are prohibited at Willapa National Wildlife Refuge, covering Leadbetter Point and Gunpowder Sands, Willapa Bay, Washington. However, a rash of night-time intrusions onto the beach occurred in late May and early June 1995 (Williamson 1995). Because of such violations, diligent surveillance and enforcement by applicable agencies is extremely important.

f. Population Monitoring

The Point Reyes Bird Observatory has been monitoring the distribution and breeding success of snowy plovers since 1977. The Point Reyes Bird Observatory is a nonprofit organization devoted to biological research for avian conservation. The current monitoring of breeding snowy plovers in Marin, Monterey, and Santa Cruz Counties, and at Vandenberg Air Force Base, is conducted by Point Reyes Bird Observatory contractors and staff. These monitoring efforts were funded in part by the National Park Service. The U.S. Geological Survey, Biological Resources Division, has monitored snowy plovers in San Diego County since 1994. These monitoring efforts were funded in part by the U.S. Marine Corps (monitoring at Camp Pendleton Marine Corps Base) and U.S. Navy, Southwest Division (monitoring at Naval Air Station, North Island, and San Clemente Island in 1997). Additional funding for surveys in Orange, Los Angeles, and San Diego Counties was obtained from the California Department of Fish and Game in 1995. The Oregon Natural Heritage Program and The Nature Conservancy have conducted snowy plover monitoring since 1990; this work has been supported by the Oregon Department of Fish and Wildlife, the U.S. Bureau of Land Management, the U.S. Forest Service, and the U.S. Fish and Wildlife Service. Some public land managers conduct varying degrees of plover population monitoring. The California Department of Parks and Recreation, Off-Road Vehicle Division, conducts annual monitoring at the Pismo/Oceano Dunes State Vehicular Recreation Area (J. Didion *in litt.* 1999).

Monitoring efforts by the Point Reyes Bird Observatory, Oregon Natural Heritage Program, and U.S. Geological Survey, Biological Resources Division, also

include banding of snowy plovers at some locations (see Figure 10). Banding provides important additional data, including information on snowy plover survival and plover migration patterns.



Figure 10. Banding a snowy plover chick (photo by Bonnie Peterson with permission)

g. Salt Pond Management

Intensive management at the Moss Landing Wildlife Area has made a major contribution to snowy plover breeding success in the Monterey Bay area. Management by Point Reyes Bird Observatory staff, in coordination with the California Department of Fish and Game, has been ongoing since 1995. Management activities include draw-down of water levels in part of the salt ponds at the beginning of the nesting season to provide dry sites for nests, and flooding of remnant wet areas twice per month through the nesting season to maintain foraging habitat for adults and their young. Predator control is conducted by the U.S. Department of Agriculture, Wildlife Services Branch.

The Don Edwards San Francisco Bay National Wildlife Refuge manages a former salt pond called the “Crescent Pond” (within CA-36 in Appendix B) for snowy plovers by reducing the water levels during the breeding season. In the future, the

Refuge anticipates that it may have to reduce vegetation in this area to increase habitat quality for plovers.

h. Habitat Acquisition

Acquisition and management of key sites is an important conservation effort. In October 1998, The Nature Conservancy transferred the approximately 193-hectare (483-acre) Lanphere-Christensen Dunes Preserve (part of Mad River Mouth and Beach, California, CA-7) to the U.S. Fish and Wildlife Service for conservation purposes. The area will be managed by the Humboldt Bay National Wildlife Refuge for natural resources, including the snowy plover. In October 1998, the Port of San Diego announced an agreement enabling approximately 560 hectares (1,400 acres) of Western Salt Company land (CA-131) to be managed by the San Diego National Wildlife Refuge. The salt ponds are a snowy plover nesting and wintering area.

i. Use of Volunteers

Volunteers contribute to the conservation of snowy plovers and their habitat at many beach locations, including Morro Bay and Oceano Dunes State Vehicular Recreation Area. Volunteers and docents assist public land managers in many ways (see Appendix K), including informing park visitors about threats to the snowy plover, reducing human and pet disturbances, and assisting with direct habitat enhancement (e.g., manual removal of European beachgrass; Figure 11).

In 1998, the Western Snowy Plover Guardian Program was developed to assist the conservation and recovery of snowy plovers in Monterey Bay. This program is mainly a volunteer effort by local citizens who assist in protecting snowy plovers through monitoring, reporting, and educational activities (D. Dixon *in litt.* 1998). Similar opportunities to coordinate volunteers for snowy plover conservation could be realized through the Coast Watch Program sponsored by the National Oceanic and Atmospheric Administration and local Adopt-a-Beach programs.



Figure 11. High School students removing European beachgrass (photo by Kerrie Palermo, with permission).

j. Public Outreach and Education

Public land managers and private conservation organizations have produced public educational materials, including brochures, posters, flyers, and informational/interpretative signs regarding snowy plovers (see Appendix K).

Environmental education/interpretation is recognized by land management agencies as an important tool that supports their mission of resource stewardship. Increased understanding and appreciation of natural resources (specifically threatened and endangered species) often results in increased public support. This support is not easily measured and when the audience is children, results may not be seen until they reach adulthood. However, those agencies conducting snowy plover education to date have found a positive response by individuals. In Oregon, on-site monitors of the U.S. Forest Service (Oregon Dunes National Recreation Area) and U.S. Bureau of Land Management report a willingness of the majority of contacted individuals to comply with restrictions after better understanding the reasons for them.

The La Purisima Audubon Society, Santa Barbara County, produced an educational video about the snowy plover in 1999.. It was distributed to public schools and museums within Santa Barbara County in 2000.

k. Section 6 Cooperative Agreements

Section 6 of the Endangered Species Act allows the U.S. Fish and Wildlife Service to enter into cooperative agreements with states that establish and maintain active programs for the conservation of listed species. Through funding under section 6, those states assist the recovery of endangered and threatened species and monitor their status. Recent projects funded by the California Department of Fish and Game, using section 6 funds, include (1) control of excessive predation of snowy plovers and California least terns by American peregrine falcons (funded in fiscal year 1998 for \$15,000) and (2) development of a corvid management plan to benefit snowy plovers, California least terns, and marbled murrelets (funded in fiscal year 1998 for \$20,000). In the State of Washington, section 6 funds have been used for funding purchase and installation of signs for protection of nesting areas, enforcement of closures, and conducting nest surveys and monitoring. Current proposals include funding these activities on an expanded basis and identifying areas to improve plover habitat suitability through experimental beachgrass control. Future proposals may include predator exclosures, should predation prove to be a limiting factor, and signing and monitoring of newly-established habitat. In Oregon, section 6 funds have been used for nest exclosures for snowy plovers, monitoring nesting success, population monitoring, and habitat management (i.e., European beachgrass control).

3. Conservation Efforts on Private Lands

Private landowners interested in conservation efforts for snowy plovers and coastal dune habitats have made important contributions to recovery efforts for coastal dune species. At Ormond Beach, California, Southern California Edison has enhanced approximately 60 hectares (150 acres) of degraded wetlands and coastal dune habitat for several special status species, including the snowy plover and California least tern (D. Pearson pers. comm. 1996).

4. Federal Regulatory Program

a. Critical Habitat

We proposed designation of critical habitat for the snowy plover in March 1995 (U.S. Fish and Wildlife Service 1995*b*). It is important to understand what critical habitat means, the status of the proposal, and how it differs from this recovery plan.

Section 3 of the Endangered Species Act defines critical habitat to mean: (i) the specific areas within the geographical area occupied by the species at the time it is listed on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed, upon determination that such areas are essential for the conservation of the species. The term “conservation” means “to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary.” Therefore, critical habitat is to include biologically suitable areas necessary to recovery of the species.

On March 2, 1995, we published a proposed rule to designate critical habitat at 28 areas along the coast of California, Oregon, and Washington (U.S. Fish and Wildlife Service 1995*b*). At that time, critical habitat was proposed to fulfill an outstanding requirement under section 4 of the Endangered Species Act to highlight important habitat areas on which activities that require Federal actions need to be evaluated under section 7 of the Endangered Species Act. A funding moratorium by the U.S. Department of the Interior for listing actions was in place during the period April 1995 to April 1996. We have subsequently acknowledged a serious backlog of listing actions and the need to prioritize them (U.S. Fish and Wildlife Service 1996*b*). Hence, we developed guidance for assigning relative priorities to listing actions conducted under section 4 of the Endangered Species Act during fiscal years 1998 and 1999 (U.S. Fish and Wildlife Service 1998). Designation of critical habitat was placed in the lowest priority (Tier 3). Under this guidance, we placed higher priority on listing imperiled species that currently

have limited or no protection under the Endangered Species Act than on devoting limited resources to the process of designating critical habitat for currently-listed species. In addition, we found that because the protection afforded by critical habitat designation applies only to Federal actions, such designation provides little or no additional protection beyond the “jeopardy” prohibition of section 7 of the Endangered Species Act, which also applies only to Federal actions (U.S. Fish and Wildlife Service 1998). Critical habitat is most likely to be useful as a tool for conserving snowy plovers where habitat is not currently occupied and it is difficult to demonstrate that an action will result in take of plovers using the site.

In December 1995, legal challenges by the Environmental Defense Center, Santa Barbara, California, against the U.S. Department of the Interior to finalize designation of critical habitat for the snowy plover were overruled by the California District Court (U.S. District Court, Central District of California 1995). At that time, the Court’s order was based on its decision that lack of funding prevented the Secretary of the Interior from taking final action on proposals for designating critical habitat. However, on November 10, 1998, the U.S. District Court for the Central District of California ruled that the Secretary of the Interior must publish a final designation of critical habitat for the snowy plover before December 1, 1999 (U.S. District Court, Central District of California 1998). The final rule designating critical habitat was published on December 7, 1999 (U.S. Fish and Wildlife Service 1999).

Critical habitat requires Federal agencies to evaluate the effects that any activities they fund, authorize, or carry out may have on listed species. Agencies are required to ensure that such activities are not likely to jeopardize the survival of a listed species or adversely modify (e.g., damage or destroy) its critical habitat. By consulting with the U.S. Fish and Wildlife Service under section 7 of the Endangered Species Act, Federal agencies can usually minimize or avoid any potential conflicts; activities have almost always been allowed to proceed in some form (U.S. Fish and Wildlife Service 1993c). Because our issuance of permits under section 10(a)(1)(B) of the Endangered Species Act constitutes a Federal action or connection and is subject to an internal section 7 consultation, habitat conservation plans developed for actions on private lands must also analyze the potential for adverse modification of critical habitat.

Critical habitat designation does not create a wilderness area, preserve, or wildlife refuge, nor does it close an area to human access or use. It applies only to activities sponsored at least in part by Federal agencies. Such federally-permitted land uses as grazing and recreation may take place if they do not adversely modify critical habitat. Designation of critical habitat does not constitute a land management plan, nor does it signal any intent of the government to acquire or control the land. Therefore, if there is no Federal involvement (e.g., Federal permit, funding, or license), activities of a private landowner, such as farming, grazing, or constructing a home, generally are not affected by a critical habitat designation, even if the landowner's property is within the geographical boundaries of critical habitat (U.S. Fish and Wildlife Service 1993c). Without a Federal connection to a proposed action, designation of critical habitat does not require that landowners of State or other non-Federal lands do anything more than they would otherwise do to avoid take under provisions of sections 9 and 10 of the Endangered Species Act.

Critical habitat designation is not necessarily intended to encompass a species' entire current range. Recovery plans, however, address all areas determined to be important for recovery of listed species and identify needed management measures to achieve recovery. The recovery units described in this recovery plan include but are not restricted to the 28 areas designated as critical habitat: Damon Point, Leadbetter Point, Bayocean Spit, Heceta Head-Sutton Creek, Siltcoos River North, Siltcoos River-Threemile Creek, Umpqua River-Horsfall Beach, Horsfall Beach-Coos Bay, and Bandon Park-Floras Lake in Recovery Unit 1; Humboldt Coast-Lagoon Beaches and Eel River Beaches in Recovery Unit 2; Bodega Bay, Dillon Beach, Half Moon Bay Beaches, Santa Cruz Coast Beaches, Monterey Bay Beaches, and Point Sur Beach in Recovery Unit 4; Arroyo Hondo Creek Beach, Arroyo Laguna Creek Beach, Morro Bay Beaches, Pismo Beach/Nipomo Dunes, Point Sal-Point Conception, Santa Barbara Coast Beaches, Oxnard Lowlands, and San Nicolas Island Beaches in Recovery Unit 5; and Malibu Lagoon, Mission Beach and Bay, and South San Diego Coast Beaches in Recovery Unit 6. As part of our efforts to conserve snowy plovers in these recovery units, we will consult with federal agencies under section 7 to ensure federally funded or permitted actions do not adversely modify critical habitat. However, implementation of the

recovery tasks in this plan (e.g., monitoring, habitat improvement, nest protection, recreation management) will not be limited to designated critical habitat areas.

b. Section 9 Take Prohibitions

Section 9 of the Endangered Species Act of 1973, as amended, prohibits any person subject to the jurisdiction of the United States from taking (i.e., harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting) listed wildlife species. It is also unlawful to attempt such acts, solicit another to commit such acts, or cause such acts to be committed. Regulations implementing the Endangered Species Act (50 CFR 17.3) further define “harm” to include significant habitat modification or degradation that results in the killing or injury of wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. “Harass” means an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding, or sheltering.

As an example under the authority of section 9 of the Endangered Species Act, on May 15, 1998, we received preliminary injunctive relief against the Town of Plymouth, Massachusetts, because their beach management failed to prevent take (killing) of a piping plover chick by an off-road vehicle (U.S. District Court for Massachusetts 1998). The judge’s order prohibited off-road vehicle traffic through the piping plover’s nesting season unless the town implemented specific management measures to preclude take, including twice-daily monitoring of nests and a 400-meter (1,148-foot) buffer of protected habitat for newly-hatched chicks.

c. Section 10 Permits

Section 10 of the Endangered Species Act and related regulations provide for permits that may be granted to authorize activities otherwise prohibited under section 9, for scientific purposes or to enhance the propagation or survival of a listed species (i.e., section 10(a)(1)(A) permits). These permits have been granted to certain biologists of conservation organizations (e.g., Point Reyes Bird Observatory and Oregon Natural Heritage Program) and Federal and State

agencies to conduct snowy plover population monitoring and banding studies and construct predator exclosures. It is also legal for employees or designated agents of certain Federal or State agencies to take listed species without a permit if the action is necessary to aid sick, injured, or orphaned animals or to salvage or dispose of a dead specimen.

Section 10(a)(1)(B) of the Endangered Species Act also allows permits to be issued for take of endangered and threatened species that is “incidental to, and not the purpose of, carrying out an otherwise lawful activity” if we determine that certain conditions have been met. An applicant for an incidental take permit must prepare a habitat conservation plan that specifies the impacts of the take, the steps the applicant will take to minimize and mitigate the impacts, funding that will be available to implement these steps, alternative actions to the take that the applicant considered, and the reasons why such alternatives are not being utilized. Conditions that we must meet include a determination: (1) whether the taking will be incidental, (2) whether the applicant will minimize and mitigate the impacts of such taking to the maximum extent possible, (3) that adequate funding for the plan will be provided, (4) that the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild, and (5) of any other measures that we may require as being necessary or appropriate for the plan. Section 10(a)(1)(B) of the Endangered Species Act provides for permits that have the potential to contribute to conservation of listed species. Such permits are intended to reduce conflicts between the conservation of listed species and economic activities, and to develop partnerships between the public and private sectors.

d. Section 7 Requirements and Consultations

Section 7(a)(1) of the Endangered Species Act requires all Federal agencies “to utilize their authorities in furtherance of the purposes of the Endangered Species Act by carrying out programs for the conservation of endangered and threatened species listed under the Act”. Hence, Federal agencies have a greater obligation than do other parties, and are required to be pro-active in the conservation of listed species regardless of their requirements under section 7(a)(2) of the Act. Section 7(a)(2) of the Endangered Species Act requires Federal agencies to

consult with the U.S. Fish and Wildlife Service prior to authorizing, funding, or carrying out activities that may affect listed species. Section 7 obligations have caused Federal land management agencies to implement western snowy plover protection measures that go beyond those required to avoid take; for example, eradicating European beachgrass and conducting research on threats to western snowy plovers. Other examples of Federal activities that may affect snowy plovers along the Pacific coast, thereby triggering a section 7 consultation, include permits for sand management activities on Federal lands (National Park Service, U.S. Department of the Interior); disposal of dredged materials (U.S. Army Corps of Engineers); and funding to public agencies for projects to repair beach facilities, such as public access paths (Federal Emergency Management Agency).

e. Other Federal Regulations, Executive Orders, and Agreements

Section 404 of the Clean Water Act (33 U.S.C. 1251-1376), as amended, and section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) are the primary Federal laws that could provide some protection of nesting and wintering habitat of the western snowy plover that is determined by the U.S. Army Corps of Engineers (Corps) to be wetlands or historic navigable waters of the United States. Excavation or placement of any fill material (including sand) below the high tide line, as defined under 33 CFR, Section 328.3(d), Definition of Waters of the United States, also requires a permit from the U.S. Army Corps of Engineers.

In September 1994, 14 Federal agencies, including the U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, National Park Service, U.S. Forest Service, U.S. Coast Guard, U.S. Army Corps of Engineers, National Marine Fisheries Service, and Department of Defense, signed a Memorandum of Understanding affirming their commitments to carry out programs for the conservation of species listed under the Endangered Species Act and the ecosystems upon which they depend, including implementing appropriate recovery actions that are identified in recovery plans (U.S. Fish and Wildlife Service 1994). Compliance with this Memorandum of Understanding would advance recovery of the snowy plover by promoting improved management of snowy plovers on Federal lands and leadership by Federal agencies in recovery unit working groups.

Executive Order 11644, Use of Off-Road Vehicles on Public Lands, and Executive Order 11989, Off-Road Vehicles on Public Lands, pertain to lands under custody of the Secretaries of Agriculture, Defense, and Interior (except for Native American Tribal lands). Executive Order 11644 requires administrative designation of areas and trails where off-road vehicles may be permitted. Executive Order 11989 states that “... the respective agency head shall, whenever he determines that the use of off-road vehicles will cause or is causing considerable adverse effects on the soil, vegetation, wildlife, wildlife habitat ... immediately close such areas or trails to the type of off-road vehicles causing such effects, until such time as he determines that such effects have been eliminated and that measures have been implemented to prevent future recurrence” (emphasis added). Compliance with this executive order would promote prohibitions or restrictions on off-road vehicles so that they are not allowed to adversely affect sensitive habitats used by snowy plovers.

Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands, provide protective policies that apply to snowy plover habitats. Executive Order 11988 mandates that all Federal agencies avoid direct or indirect support of floodplain development wherever there is a practicable alternative. Executive Order 11990 mandates that all Federal agencies shall “provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands...” Compliance with Executive Order 11988 would promote protection of beach and dune habitats through restrictions on development within floodplains. Application of Executive Order 11990 would promote protection of wetland habitats used by snowy plovers.

Executive Order 13112, Invasive Species, directs Federal agencies to prevent the introduction of invasive species; control their populations in a cost-effective and environmentally sound manner; monitor invasive species; restore native species and habitat conditions in ecosystems that have been invaded; conduct research and develop technologies to prevent their introduction; and promote public education on invasive species and the means to address them. This executive order also requires that a Federal agency “not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive

species...” Compliance with this executive order would enhance snowy plover habitats through (1) avoidance of use, approval, or funding the planting of invasive species like European beachgrass; and (2) active programs to remove this invasive species and restore coastal dune habitats with native plant species.

The Fish and Wildlife Coordination Act (16 U.S.C. 661-667e), as amended, requires that whenever a proposed public or private development is subject to Federal permit, funding, or license, the conservation of fish and wildlife resources shall be given equal consideration. This Act also requires that project proponents shall consult with the U.S. Fish and Wildlife Service and the State agency responsible for fish and wildlife resources. Compliance with the Fish and Wildlife Coordination Act highlights the importance of considering and providing for the habitat needs of fish and wildlife resources when reviewing projects that would adversely affect these resources.

The National Environmental Policy Act of 1969, (42 U.S.C. 4321-4347), as amended, requires that each Federal agency prepare an environmental impact statement on the potential environmental consequences of major actions under their jurisdiction. Environmental impact statements must include the impacts on ecological systems, any direct or indirect consequences that may result from the action, less environmentally damaging alternatives, cumulative long-term effects of the proposed action, and any irreversible or irretrievable commitment of resources that might result from the action. Compliance with the National Environmental Policy Act highlights the need to disclose, minimize, and mitigate impacts to biological resources, including snowy plovers.

The Coastal Zone Management Act of 1972 (16 U.S.C. 1451-1464), as amended, established a program for states to voluntarily develop comprehensive programs to protect and manage coastal resources. To receive Federal approval and funding under this Act, states must demonstrate that they have programs and enforceable policies that are sufficiently comprehensive and specific to regulate land uses, water uses, and coastal development, and must have authorities to implement enforceable policies. Local coastal plans, local comprehensive plans, and implementing measures by coastal planning jurisdictions pursuant to the Coastal

Zone Management Act should be developed, updated, and implemented with protective measures for snowy plovers.

Snowy plovers are protected under the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712), as amended. Under the Migratory Bird Treaty Act, prohibited acts include pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting any migratory bird, nest, or eggs without a permit from the U.S. Fish and Wildlife Service.

5. State Regulatory Protection, Policies, and Agreements

In Washington, Oregon, and California, each state holds title to, and has regulatory jurisdiction over, the coastal intertidal zone. In Washington, the area between mean high tide to extreme low tide is the seashore conservation area under the authority of the Washington State Parks and Recreation Commission. In California, the California State Lands Commission has regulatory authority to the mean high tide line along the California coast.

In Oregon, the Oregon Parks and Recreation Department administers the State beach for the ocean shore recreation area, which is defined as the area between the line of extreme low water and the statutory vegetation line, which is a line surveyed to the approximate line of vegetation that existed in 1969 (Oregon Revised Statutes 390.770). The Oregon Division of State Lands also has jurisdiction over waters of the state along the Pacific coast to the line of highest tide or the line of established vegetation, whichever is higher. Therefore, the Oregon Parks and Recreation Department has direct jurisdiction, authority, and responsibility for management of snowy plover habitats in the State of Oregon, which owns not only to the mean high tide line, which is snowy plover foraging habitat, but also into the vegetation line, which is essentially the dry sand area used by snowy plovers for nesting.

State coastal planning and regulatory agencies, such as the California Coastal Commission, require preparation of local coastal zone management plans by local coastal municipalities. These local coastal zone management plans must comply with the Coastal Zone Management Act of 1972 regarding protection of coastal

resources, including natural resources. Under the California Coastal Management Program, coastal resources are managed and cumulative impacts addressed through: (1) coastal permits and appeals; (2) planning and implementation of local coastal programs; and (3) Federal consistency review. However, effective management of cumulative impacts is difficult under the existing management framework because multiple jurisdictions have varying policies and standards in different geographic areas (California Coastal Commission 1995). Through the Coastal Commission's regional cumulative assessment program, cumulative impacts to coastal resources can be addressed through the periodic review of local coastal programs. In California, most local coastal programs and general plans were completed prior to 1993 (when we listed the snowy plover as a threatened species); therefore, many do not reflect protective measures specifically for the plover.

The Oregon Department of Land Conservation and Development is the designated coastal zone management agency for the State of Oregon. The state of Oregon's land use planning system has several elements that are related to conservation of western snowy plovers and their habitats. In Oregon, local jurisdictions (cities and counties), service districts, and State agencies are required to develop Local Comprehensive Plans and Implementing Measures, such as zoning and land division ordinances, to effect these plans. Each plan must satisfy a set of 19 goals established through Oregon land use law and policy. Plans must be reviewed by the Land Conservation and Development Commission for consistency with these goals before they can be put into effect. Several of the planning goals have application to, or should be considered during, planning for plover conservation and recovery. These goals include: Goal 5 - Open Spaces, Scenic and Historic Areas, and Natural Resources; Goal 7 - Areas Subject to Natural Disasters and Hazards; Goal 8 - Recreational Needs; Goal 16 - Estuarine Resources; Goal 17 - Coastal Shorelands; and Goal 18 - Beaches and Dunes.

Taken in aggregate, the elements of these goals that can contribute to snowy plover recovery include:

- several requirements for protection of wildlife habitat;

- requiring protection of estuarine ecosystems including habitats, diversity, and other natural values;
- establishing that uses of beaches and dunes shall be based on factors including the need to protect areas of critical environmental concern and significant wildlife habitat;
- requiring that coastal plans provide for uses of beaches and dunes that are consistent with their ecological values and natural limitations;
- requiring an evaluation of the beneficial effects to natural resources from allowing continuation of natural events that are hazardous to human developments (such as erosion and ocean flooding);
- establishing a preference for nonstructural solutions to erosion and flooding of coastal shorelands over structural approaches (such as seawalls and rip-rap);
- requiring that development of destination resorts be compatible with adjacent land uses and maintain important natural features such as threatened and endangered species habitats;
- encouraging coordination among State, Federal, and local governmental agencies while developing recreation plans, and discouraging development of recreation plans that exceed the carrying capacity of the landscape;
- encouraging planning for Open Space, Scenic and Historic Areas, and Natural Resources (Goal 5), Recreational Needs (Goal 8), and Coastal Shorelands (Goal 17) in close coordination; and
- allowing dune stabilization programs only when in conformance with the overall comprehensive plan and after assessment of the potential impacts.

Some aspects of these planning goals could be interpreted to be contrary to snowy plover conservation and recovery when viewed in isolation. However, when viewed in the context of the entire goal or all the planning goals, these elements should be compatible with plover conservation and carefully-planned habitat restoration activities. Two such elements are the directive to increase recreational access to coastal shorelands and the restrictions placed on dune grading and removal of vegetation. Goal 17 - Coastal Shorelands directs local governments and the Oregon Parks and Recreation Department to develop a program to increase public access. In many areas, recreational use of plover habitat during the nesting season is detrimental to or incompatible with plover conservation.

However, this goal also recognizes that many shorelands have unique or exceptional natural area values, includes the objective of reducing adverse impacts associated with use of coastal shorelands to fish and wildlife habitat, clearly establishes that significant wildlife habitat shall be protected, establishes that uses of such habitat areas shall be consistent with protection of natural values, and directs recreation plans to provide for "appropriate" public access and recreational use. Goal 18 - Beaches and Dunes directs local governments and State and Federal agencies to regulate actions in beach and dune areas to minimize any resulting erosion and only allows foredune breaching to replenish interdune areas or in the case of an emergency. Plover habitat restoration efforts in areas that have been overtaken by European beachgrass (*Ammophila arenaria*) may involve foredune breaching, vegetation removal, dune grading, and other actions that will remove the European beachgrass and restore the natural beach and dune processes of sand movement, including erosion and deposition. However, this goal also recognizes the need to protect areas of critical environmental concern, areas of biological importance, and areas with significant habitat value, specifically identifies removal of "desirable" vegetation as an action requiring minimization of erosion, and requires that any foredune breaching be consistent with sound principles of conservation.

The Washington State Parks and Recreation Commission administers the Seashore Conservation Act of 1988 in accordance with the Revised Code of Washington and the Washington Administrative Code. The Seashore Conservation Area (Revised Code of Washington 43.51) emphasizes the importance of beaches to the public for recreational activities. In designating beach areas to be reserved for pedestrian use, it considers natural resources, including protection of shorebird and marine mammal habitats, preservation of native beach vegetation, and protection of sand dune topography. Chapter 352-37 (Ocean Beaches) of the Washington Administrative Code requires local governments within the Seashore Conservation Area to prepare recreation management plans that designate at least 40 percent of the ocean beach for use by pedestrians and nonmotorized vehicles from April 15 to the day after Labor Day. These regulations also identify restrictions on certain uses within ocean beaches, including motor vehicles, equestrian traffic, speed limits, aircraft, wind/sand sailers, parasails, hovercraft, group recreation events, and beach parking and

camping. In 1989, an interagency agreement was signed by the Washington Department of Natural Resources, Washington State Parks and Recreation Commission, Washington Department of Wildlife, and City of Ocean Shores regarding management of mixed uses at Damon Point. The intent of the agreement was to protect snowy plovers while allowing recreation.

State regulations, policies, and goals for the States of California, Oregon, and Washington provide many protective measures for snowy plovers. However, because they frequently emphasize public uses of beach habitat, there is potential for conflicts between human uses of the coastal zone and needed management measures for recovery of the snowy plover. To minimize these conflicts, this recovery plan recommends that the California Coastal Commission, Oregon Department of Land Conservation and Development, State of Washington Parks and Recreation Commission, Oregon Parks and Recreation Department, California Department of Parks and Recreation, and Oregon Department of Fish and Wildlife (regarding the Oregon Endangered Species Act) review their local coastal programs, regulations, policies, and goals for consistency with this recovery plan and implement any necessary revisions (see Task 3.1.7).

6. Consultations, Habitat Conservation Plans, and Other Regulatory Actions

Through consultations with Federal agencies under section 7 of the Endangered Species Act and through the development of habitat conservation plans with non Federal agencies developed under section 10 of the Endangered Species Act, we provide nondiscretionary terms and conditions that minimize (sections 7 and 10) and mitigate (section 10) the impacts of covered activities on listed species and their habitat. Several major consultations and habitat conservation planning efforts to benefit the snowy plover have been completed or are currently under way.

In November 1995, our Sacramento Fish and Wildlife Office completed formal consultation with the National Park Service, Golden Gate National Recreation Area, on the effects of their management of Ocean Beach, San Francisco, on the snowy plover. Ocean Beach experiences tremendous visitor use year-round because of its proximity to San Francisco, yet it supports high numbers of

nonbreeding plovers, which may be present from May through July. The consultation covered actions and policies the National Park Service had taken that resulted in unnecessary harassment of nonbreeding plovers. Most significant of these measures was their policy not to enforce regulations requiring pets to be leashed and under control by their owners on all National Park Service lands. Data collected by the National Park Service clearly identified that unleashed dogs were the most significant disturbance factor of the many sources of disturbance to snowy plovers on Ocean Beach. As a result of the consultation, the National Park Service began to enforce their “leash law” along 3.2 kilometers (2 miles) of beach utilized by plovers. The National Park Service implemented this policy despite vocal and persistent opposition by the San Francisco Society for the Prevention of Cruelty to Animals and other local advocacy groups, including the “Rovers for Plovers”, which organized themselves to challenge the National Park Service’s leash law. These groups were successful in advocating their position in numerous television news stories and articles in local newspapers. At the height of this discourse, the local public radio station held a round-table discussion between the National Park Service, U.S. Fish and Wildlife Service, and Society for the Prevention of Cruelty to Animals, and solicited audience members to call in and identify their viewpoint. The overwhelming majority of callers supported leash law restrictions that would minimize harassment of plovers.

Our Arcata Fish and Wildlife Office is informally consulting with gravel operators on the Eel River, California. Gravel mining operations are subject to permits from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. The snowy plover breeds on the Eel River gravel beds. Impacts to snowy plover associated with gravel mining operations will be assessed based on nesting surveys, and may require take authorization through formal consultation. The Arcata Fish and Wildlife Office is also working with Humboldt County, the California Department of Fish and Game, and the California Department of Parks and Recreation to implement additional protections for nesting plovers at MacKerricher State Park, Clam Beach and the Eel River Wildlife Area. These measures include installation of nest exclosures, signing, and development of educational material for kiosks. We are also providing technical assistance to Redwood National Park and MacKerricher State Park on exotic vegetation management programs (J. Watkins *in litt.* 1999, J. Watkins pers. comm. 2001).

Our Ventura Fish and Wildlife Office is attempting to initiate a regional approach to habitat conservation planning for snowy plovers and other listed species along Monterey Bay in Monterey County, California. Currently, there are several proposed development projects within the cities of Marina and San City and each of these cities is preparing a "city wide" habitat conservation plan for their respective jurisdictions. We have expressed concerns about these projects being presented in a piecemeal fashion, which does not allow an adequate assessment of their cumulative effects, and we have recommended a regional approach through preparation of a regional habitat conservation plan. This plan would provide greater conservation benefits to the snowy plover. In addition to the adverse effects of development on snowy plovers and their habitat, recreation on the extensive public lands along Monterey Bay is also adversely affecting snowy plovers. Therefore, public land managers, including our Refuges Division, the California Department of Parks and Recreation, the California Department of Fish and Game, and the Monterey Peninsula Regional Park District, need to be involved in planning efforts along Monterey Bay.

In January 2001 the Ventura Fish and Wildlife Office released a draft biological opinion on Vandenberg Air Force Base's proposed beach management plan for the snowy plover, concluding that the plan would "likely jeopardize the continued existence of the western snowy plover and adversely modify its critical habitat." The Air Force's beach plan would have allowed twice as much nesting habitat to be open to public recreation as was allowed during the 2000 breeding season, and it would have reduced the time the Air Force spends patrolling the beaches by about 80 percent. The Air Force subsequently reinitiated consultation on a modified version of the beach management plan, including commitments to signage, information kiosk, and enforcement patrols. The Ventura Fish and Wildlife Office issued a non-jeopardy biological opinion on the modified action in March 2001; as of early April, opening of the beach and full implementation of conservation measures had not yet taken place (S. Henry pers. comm. 2001).

The Ventura Fish and Wildlife Office is also involved with the development of a habitat conservation plan being funded by the Off-Road Vehicle Division of the California Department of Parks and Recreation for the Pismo/Oceano Dunes State Vehicular Recreation Area and other State parks within the San Luis Obispo

District of the California Department of Parks and Recreation. The habitat conservation plan will evaluate the effects that recreation and park management activities are having on the covered species, including the snowy plover.

In the past, several instances were documented of snowy plover nests being trampled by cattle belonging to the Vail and Vickers Company on Santa Rosa Island within the Channel Islands National Park, owned and managed by the National Park Service. In 1996, a lawsuit to remove cattle from Santa Rosa Island was initiated by the Environmental Defense Center, Santa Barbara, on behalf of the National Park Conservation Association. It was initiated under the authority of the Clean Water Act and the Endangered Species Act, based on concerns about management of livestock by the National Park Service and associated impacts to water quality and sensitive plant and animal species. As a result of a lawsuit settlement, all cattle were removed from Santa Rosa Island in early 1998. Through the years, reproductive success for snowy plovers has been poor on Santa Rosa Island. Ravens occurred regularly in the area associated with the cattle operation. It remains to be seen whether removal of cattle will change this trend. Deer and elk, occasional users of snowy plover nesting beaches, will remain on the island until 2011.

7. Regulatory Protection and Policies of Local Governments

Local governments regulate municipal land uses through development of local land use plans, general plans, comprehensive plans, and zoning policies. On April 21, 1998, we requested that county and coastal city planners within the states of Washington, Oregon, and California complete land-use management surveys regarding the snowy plover. We sent surveys to 91 State, county, or coastal city planners and received responses from 37 percent of the recipients. Approximately 50 percent of the respondents were aware that snowy plover habitats occur within their jurisdictions. However, only about one-third knew whether sandy beach and other habitats within their jurisdictions provided breeding and/or wintering habitat for plovers. Many general plans, coastal zone programs, and comprehensive plans prepared by local governments contain land use designations that are protective of snowy plover habitats (e.g., parkland, open space, and conservation designations for sandy beach). However, allowable uses in or adjacent to these zones, such as

development (e.g., seawalls, recreational facilities, single-family homes), recreation and public access, could cause direct or indirect threats to breeding or wintering plovers.

Whereas 43 percent of the respondents include regulatory policies that protect snowy plover habitat (e.g., sandy beach) in their general plans, local coastal programs or comprehensive plans, only 3 of the 34 respondents (8 percent), have developed regulatory policies specifically to protect the plover. These respondents included the City of Half Moon Bay, California, and Coos and Curry Counties, Oregon. Only 8 of the 34 respondents (23 percent) specifically explain the threatened status of the snowy plover, identify plover breeding/wintering locations, or specify shorebird nesting/roosting habitats as environmentally sensitive habitat areas in their jurisdictions. About 50 percent of the respondents indicated they either (1) have approved development within or adjacent to sandy beach or other habitats used by the snowy plover, or (2) did not know whether such development had been approved by their agency. About half of these same respondents could provide some information on the number of permits authorized, area or linear distance affected, percentage of development types (e.g., housing, recreational) permitted, and permit conditions.

Based on these responses, it seems that specific locations of, and protective measures for, snowy plover breeding and/or wintering locations are not included in most of the existing general plans, comprehensive plans, local coastal programs, or their implementing ordinances. Also, to better assess cumulative impacts, these responses indicate a need for a better tracking method regarding development projects approved within and adjacent to snowy plover habitat.

8. Interagency Coordination

Since 1992, the Western Snowy Plover Working Team for Oregon has been meeting at least twice a year to coordinate plover recovery efforts. This working group has provided a forum for the participation of affected Federal and State agencies, conservation organizations, user groups, and environmental groups in discussion, implementation, and adjustment of recovery efforts in Oregon. Items addressed include monitoring needs, predator control, signage, exclosures,

nonnative vegetation removal, and public outreach and education. This group also facilitates funding partnerships for monitoring and management programs, thus promoting the best use and leveraging of limited funds. It also acts as the main forum for discussing and tracking the status and trends of the Oregon/Washington snowy plover subpopulation.

In 1998, an interagency effort in Oregon produced a slide show and portable display to educate beach visitors about snowy plover conservation. Outdoor education specialists and/or plover biologists from the U.S. Bureau of Land Management, U.S. Forest Service, Oregon Department of Fish and Wildlife, Oregon Parks and Recreation Department, and U.S. Fish and Wildlife Service participated in this effort. The show provides basic information about the plover, the reasons for its decline, and actions needed for its recovery, emphasizing the contribution that beach visitors can make.

In California, biannual plover coordination meetings are held among Federal and State agencies and Point Reyes Bird Observatory staff to track the breeding population of plovers in the Monterey Bay area. Meetings of this working group have been ongoing since 1991. Management needs such as exclosures, symbolic fencing, predator control, removal of exotic vegetation, and acquisition of key sites are considered and planned through this forum.

II. RECOVERY

A. RECOVERY OBJECTIVE

The objective of this recovery plan is to ensure the long-term viability of the U.S. Pacific coast western snowy plover population so that this population can be removed from the Federal list of endangered and threatened species.

B. RECOVERY CRITERIA

The Pacific coast population of the western snowy plover will be considered for delisting when the following criteria have been met:

Criterion 1. Maintain for 10 years an average of 3,000 breeding adults distributed among 6 recovery units as specified below:

<i>Recovery Unit</i>	<i>Subpopulation Size</i>
1. Washington and Oregon	250 breeding adults
2. Del Norte to Mendocino Counties, California	150 breeding adults
3. San Francisco Bay, California	500 breeding adults
4. Sonoma to Monterey Counties, California	400 breeding adults
5. San Luis Obispo to Ventura Counties, California	1,200 breeding adults
6. Los Angeles to San Diego Counties, California	500 breeding adults

Subpopulation sizes represent the best professional judgment of the western snowy plover recovery team's technical subteam. Numbers are based on a site-by-site evaluation of historical records, recent surveys, and future potential (assuming dedicated, proactive management at breeding and wintering locations). Collectively, these numbers represent an approximately 50 percent increase in the Pacific coast population size. They are about 15 percent below the "Management

Goal Breeding Numbers” identified in Appendices B and C, which represent target populations under an intensive management scheme. The recovery criteria for population size and distribution for the U.S. Pacific Coast population of the western snowy plover represents only a portion of its historical abundance and distribution.

To reach these subpopulation sizes will require proactive management to attain a level of productivity that will allow the population to grow. The population viability analysis (Appendix D) suggests that reproductive success between 1.2 to 1.3 fledglings per male per year, with adult survival of 76 percent and juvenile survival of 50 percent, provides a 57 to 82 percent probability of reaching a population of 3,000 snowy plovers within 25 years. Enhancing productivity is critical to population growth. Once the population size criterion is met, a lower rate of productivity can sustain the population. This criterion is primarily connected to improvement in listing factor 1 (the present or threatened destruction, modification, or curtailment of their habitat or range), and secondarily to listing factors 3 (disease and predation) and 5 (other natural or manmade factors affecting their continued existence).

Criterion 2. Maintain a 5-year average productivity of at least one fledged chick per male in each recovery unit in the last 5 years prior to delisting.

From currently available data, it is estimated that males must average one fledged young annually for population equilibrium (see Appendix D). This criterion is primarily connected to improvement in listing factors 3 (disease and predation) and 5 (other natural or manmade factors affecting their continued existence), and secondarily to listing factor 2 (overutilization for commercial, recreational, scientific, or educational purposes).

Criterion 3. Have in place participation plans among cooperating agencies, landowners, and conservation organizations to assure protection and management of breeding, wintering, and migration areas listed in Appendix B to maintain the subpopulation sizes and average productivity specified in criteria 1 and 2.

Development of participation plans is listed under Task 3.1.2. (Table 6) at the end of this chapter, which outlines the recovery actions recommended to meet these recovery criteria, and in the stepdown narrative section, which describes each action in detail. The stepdown narrative lists all subtasks necessary to fulfill the main recovery task. It also represents a prioritization of measures to be implemented. This criterion is primarily connected to improvement in listing factor 4 (the inadequacy of existing regulatory mechanisms).

C. RECOVERY STRATEGY

1. Principles for Recovery

The following principles will guide future recovery efforts for the U.S. Pacific coast population of the western snowy plover.

- a. Population increases should be distributed throughout the snowy plover's Pacific coast range.

Dispersal of the population across its breeding range helps to counterbalance catastrophes, such as extreme climatic events, oil spills, or disease that might depress regional survival and/or productivity. Maintaining robust, well-distributed subpopulations should reduce variance in survival and productivity of the Pacific coast population of the western snowy plover as a whole, facilitate interchange of genetic material between subpopulations, and promote recolonization of any sites that experience declines or local extirpations due to low productivity and/or temporary habitat loss.

This recovery plan and the population viability analysis (Appendix D) consider the U.S. Pacific Coast population of the snowy plover to be a single management entity, and population goals and objectives are based on that premise. The recovery team recommends that no state, geographic region, or subpopulation of the Pacific coast population of the snowy plover be considered for delisting separately from the others.

b. Intensive, ongoing management of snowy plovers and their habitats is essential for recovery, and mechanisms to continue this management after delisting to prevent a reversal of population increases following delisting under the Endangered Species Act.

c. Annual monitoring of snowy plover populations and reproductive success is essential for adaptive management and to determine the success of recovery efforts.

2. Roles of Federal, State, Local, and Private Sectors

a. Role of Federal Lands

Federal lands administered by the U.S. Fish and Wildlife Service, National Park Service, U.S. Forest Service, U.S. Bureau of Land Management, U.S. Marine Corps, and the U.S. Departments of the Army (including Corps of Engineers), Navy, and Air Force are extremely important to the conservation of the snowy plover. As of 1988, approximately 34 percent of the breeding plover population in California occurred on Federal lands (J.P. Myers *in litt.* 1988). Within San Diego County, 72 to 87 percent of snowy plover nests were located on Federal properties from 1994 to 1997; the majority were located on military bases (Powell *et al.* 1997). In 1988, at least 50 percent of the plover's breeding habitat was under Federal agency jurisdiction in Oregon (J.P. Myers *in litt.* 1988). However, the State of Oregon also has jurisdiction over much of this area (from mean high tide to the vegetation line) through a recreational easement (E.Y. Zielinski and R.W. Williams *in litt.* 1999). In Washington, the breeding site at Leadbetter Point is within a national wildlife refuge.

Under section 7(a)(1) of the Endangered Species Act, Federal agencies are required to actively promote the conservation of listed species. The snowy plover cannot be recovered simply through general habitat protection or complying with required section 7 consultations. The snowy plover *must be actively monitored and managed for the full purposes of recovery* or its population size will continue to decline. Federal agencies alone cannot assure recovery of the snowy plover, but they need to significantly increase their current monitoring and management

efforts now to assure survival and recovery of this species. Reasons why Federal agencies should take this lead role include the following: (1) some Federal agencies, including military agencies, do not have a recreational mandate and, thus, may have fewer competing uses to their conservation responsibilities; (2) some Federal lands contain large areas of contiguous habitat, including adjacent inland areas that are easier to manage for conservation of natural resources than fragmented, linear strips of land that may be owned by states, counties, cities, and private landowners; and (3) in general, Federal agencies have larger budgets and more resources to allocate for monitoring, management, research, and other programs that could benefit plovers and their habitat. Protection of snowy plovers and their habitat on Federal lands is important not only because of the direct benefits to plovers that use these areas, but also because plover protection programs on Federal lands frequently utilize state-of-the art management measures (e.g., exclosures) and therefore serve as examples to non-Federal landowners. The Federal Government also should take the lead in addressing the sensitive issue of predator control.

b. Role of State Lands

State lands administered by the California Department of Parks and Recreation, California Department of Fish and Game, Oregon Department of Fish and Wildlife, Oregon Parks and Recreation Department, Washington Department of Fish and Wildlife, Washington State Parks and Recreation Commission, and Washington Department of Natural Resources play an important role in conservation of snowy plovers and their habitats. Intensive management for snowy plovers occurs at a number of state-owned plover habitat areas. The snowy plover cannot be preserved simply through general habitat protection. Snowy plovers must be actively monitored and managed to achieve recovery goals on State lands or their population size will continue to decline.

c. Roles of State and Local Governments

State and local government agencies, including State planning agencies and city and county planning and community resources departments, have the primary responsibility for overseeing land uses within their jurisdictions. Therefore, their

involvement in future recovery planning processes is critical. All Appendix B locations should be identified as environmentally sensitive habitat areas requiring protective measures for the plover in State and local planning documents and zoning designations. Local coastal programs should be amended to include these areas. To facilitate this effort, Federal and State agencies managing snowy plover habitat should provide technical assistance and information to local governments (see Tasks 3.1.6, 3.1.7 and 5.2). We can provide detailed maps of current snowy plover breeding and/or wintering locations; these maps will be updated periodically as needed.

d. Role of Municipal Lands

Regional, county, and city lands, including regional and municipal park districts, also serve a role in conserving breeding and wintering habitats for snowy plovers. Because these areas frequently receive heavy pedestrian and recreational use, local jurisdictions with active public outreach programs can reach a large segment of the coastal community regarding the plover's status and habitat needs.

e. Role of Private Lands

Conservation efforts on private lands are needed for the survival and recovery of many listed and other sensitive species. Private landowners can also make important contributions to snowy plover conservation through facilitating or allowing the monitoring of snowy plover populations on their land and implementing protective measures.

3. Conservation Tools and Strategies

There are numerous conservation tools and strategies available to Federal, State, municipal, and private landowners interested in snowy plover protection and recovery. Appendix H includes a summary of conservation tools and strategies available to landowners, nonprofit organizations, and regulatory agencies that may be adopted to protect snowy plover habitat.

4. Funding Sources

Grants under section 6 of the Endangered Species Act provide states with resources to implement a wide array of recovery activities that include population monitoring and habitat restoration. Appendix I includes a summary of some other potential sources of funds for implementation of recovery actions for the snowy plover. Appendix I includes only a partial list of potential funding sources. Other funding opportunities may be possible.

An essential mechanism for recovery of the snowy plover is the development and implementation of participation plans for each of the six recovery units (see Task 3.1.2). A key element of these participation plans is the long-term commitment by participating agencies to seek annual, ongoing funding for snowy plover management and monitoring activities so that funding within agency budgets can be secured.

In many areas a significant portion of snowy plover conservation resources are expended in efforts to minimize the adverse impacts of recreation. Often, the primary objective of signs, ropes, on-site interpretation, and enforcement is to manage the behavior of beach-goers such that impacts to plovers are reduced as much as possible. In areas that have suffered extensive habitat loss or degradation, such recreation management activities are an extremely high priority in order to protect the plovers using the limited habitat that remains. For some beach managers, much of the funding and staff time expended on recreation management in and near plover habitat comes from resources targeted for threatened and endangered species recovery. In absence of the need to coordinate and pay for recreation management activities, more of these limited conservation dollars and staff resources could be directed toward plover management actions such as biological monitoring, habitat restoration, and predation control.

This situation is unique in the experience of many resource biologists. More typically, avoidance, minimization, and mitigation measures are integral components of projects or programs that entail adverse impacts to sensitive resources, and the costs of these activities are regarded to be part of the overall cost of the project or program. Applying this traditional construct to recreation

projects and programs could significantly promote snowy plover recovery in several ways. First, it would require impacts to plovers to be considered up front when planning beach access or other recreation projects. Second, it would encourage impact avoidance and minimization since such measures are often less expensive than mitigation. Third, it would promote involvement of recreation professionals in designing and implementing recreation management measures. And fourth, it would eliminate or reduce the diversion of biological resource management funds toward recreation management activities, thus enabling more of those dollars to be spent on snowy plover recovery actions.

5. Coordination, Participation, and Working Groups

We strongly believe that a collaborative stewardship approach to the proactive management of listed species involving government agencies (Federal, State, and local) and the private sector is critical to achieving the ultimate goal of recovery of listed species under the Endangered Species Act. An essential mechanism to achieve recovery of the snowy plover is the formation of working groups for each of the six recovery units (see Appendix A), covering the following areas: (1) Oregon and Washington; (2) Northern California (Del Norte, Humboldt, and Mendocino Counties); (3) San Francisco Bay (locations within Counties of Napa, Alameda, Santa Clara, and San Mateo); (4) Monterey Bay (including coastal areas along Counties of Monterey, Santa Cruz, San Mateo, San Francisco, Marin, and Sonoma); (5) San Luis Obispo, Santa Barbara, and Ventura Counties; and (6) Los Angeles, Orange, and San Diego Counties (see Task 3.1.1). Representation from the full contingency of Federal, State, local, and private landowners and other parties who have a stake in snowy plover conservation within each of these six recovery units will be needed to advance the recovery actions recommended in this recovery plan. The Monterey and Oregon working groups should be expanded and used as models for establishing new working groups. Working group membership should include land managers, environmental groups, user groups, and groups involved in conservation projects (including local chapters of the National Audubon Society, Sierra Club, Native Plants Society, Americorps, California Conservation Corps, Boy Scouts, Surfrider Foundation, and other recreational use groups). These groups could provide large networks of volunteers who could be mobilized to assist public resource agencies in the

implementation of management measures for protection and recovery of the snowy plover.

It is expected that many agencies and individuals on the recovery team will continue to participate in the working groups, which are ongoing or will be developed for the six recovery units. Through evaluation, communication, and coordination, members of each of the six working groups should manage the snowy plover population and monitor progress towards recovery. They should produce annual reports on population monitoring and the effectiveness of management activities for the working group and the recovery leader within our Sacramento Fish and Wildlife Office. Each of the six working groups should prepare a participation plan, thereby formalizing recovery implementation efforts and the intentions of responsible agencies to seek ongoing, annual funding for recovery implementation. The recovery leader should coordinate and communicate with each recovery unit to support recovery efforts and assure implementation of the recovery plan (see Tasks 3.1.1 through 3.1.4, 6, and 7). A coordinated international conservation program with Mexico should also be established to protect snowy plover populations and their habitat in that country (see Task 8).

Table 6. Recovery Task Outline

1 Monitor and manage breeding habitat of the Pacific coast population of western snowy plovers to maximize survival and productivity.

- 1.1 Monitor the snowy plover breeding population.
 - 1.1.1 Annually monitor population size and distribution at breeding locations in each recovery unit.
 - 1.1.2 Monitor productivity.
 - 1.1.3 Monitor annual survival.
 - 1.1.4 Monitor snowy plover breeding activities at all breeding sites to identify factors limiting abundance of breeding birds, clutch hatching success, and chick fledging success.
 - 1.1.5 Develop training and certification programs for snowy plover survey coordinators.
 - 1.1.6 Improve submittal system for monitoring data.
 - 1.1.7 Evaluate and update lists of important breeding areas as data become available.
 - 1.1.8 Coordinate monitoring of snowy plovers and California least terns.
- 1.2 Maintain natural coastal processes that perpetuate high quality breeding habitat.
 - 1.2.1 Avoid development that will destroy or degrade snowy plover breeding habitat.

- 1.2.2 Avoid interference with natural processes of inlet formation, migration, and closure.
- 1.2.3 Avoid interference with natural processes of erosion and deposition of sand dunes.
- 1.2.4 Avoid beach stabilization projects.
- 1.2.5 Remediate and compensate the disruption of natural processes by creating and enhancing existing and potential breeding habitat.
 - 1.2.5.1 Remove nonnative and other invasive vegetation from existing and potential breeding sites.
 - 1.2.5.2 Deposit dredged material to enhance or create nesting habitat, and evaluate impacts from beach nourishment activities.
 - 1.2.5.3 Create, manage, and enhance coastal ponds and playas for breeding habitat.
- 1.3 Prevent disturbance of breeding snowy plovers by people and domestic animals.
 - 1.3.1 Prevent pedestrian disturbance.
 - 1.3.1.1 Seasonally close, fence, post, use exclosures, monitor, and enforce regulations in areas used by breeding snowy plovers as appropriate.
 - 1.3.1.2 Develop and implement necessary State and local ordinances, administrative rules, and regulations to enforce closed areas on beaches used as breeding habitat.

- 1.3.1.3 Locate access points and trails well away from snowy plover nesting habitat.
 - 1.3.1.4 Implement and enforce pet restrictions.
 - 1.3.1.5 Prevent disturbance from disruptive recreational activities where breeding snowy plovers are present.
 - 1.3.1.6 Prevent driftwood removal.
 - 1.3.1.7 Implement and enforce anti-littering regulations.
- 1.3.2 Prevent disturbance, mortality, and habitat degradation by off-road vehicles, including beach-raking machines.
- 1.3.3 Implement and enforce restrictions on horseback riding in nesting areas.
- 1.3.4 Provide wardens, agents, or officers to enforce protective measures in breeding habitat.
- 1.3.5 Develop and implement training programs for enforcement personnel and others who work in snowy plover breeding habitat.
- 1.3.6 Ensure that enforcement efforts do not endanger snowy plovers, their nests, eggs, or chicks.
- 1.4 Prevent excessive predation of snowy plovers.
 - 1.4.1 Remove litter and garbage from beaches manually, not by raking machines.
 - 1.4.2 Remove predator perches and unnatural habitats.

- 1.4.3 Erect predator exclosures to reduce snowy plover egg predation where appropriate.
- 1.4.4 Remove predators where warranted and feasible.
- 1.4.5 Remove bird and mammal carcasses in snowy plover nesting areas.
- 1.5 Protect snowy plovers and their breeding habitat from oil or chemical spills.
- 1.6 Replace exotic dune plants with native dune vegetation where it is likely to improve breeding habitat for snowy plovers.
- 1.7 Compensate the loss of snowy plover breeding habitat associated with recovery efforts for other sensitive species, including those within the San Francisco Bay recovery unit.
- 1.8 Discourage pinnipeds from usurping snowy plover nesting areas.

2 Monitor and manage wintering and migration areas to maximize snowy plover population survival.

- 2.1 Monitor known and potential wintering locations.
 - 2.1.1 Monitor snowy plover abundance and distribution at wintering locations in each recovery unit.
 - 2.1.2 Identify factors limiting the quality of wintering locations.
 - 2.1.3 Quantify wintering habitat needs of snowy plovers along the Pacific coast.
 - 2.1.4 Evaluate and update lists of important wintering areas as data become available.

- 2.2 Prevent human degradation and disturbance of snowy plover wintering habitat.
 - 2.2.1 Protect wintering habitat from impacts of water diversion/impoundment and shoreline stabilization, navigation, and development projects.
 - 2.2.2 Protect wintering habitat from disturbance by people and domestic animals.
 - 2.2.3 Develop and implement necessary State and local ordinances, administrative rules, and regulations to enforce closed areas on beaches used as snowy plover wintering habitat.
 - 2.2.4 Provide trained wardens, agents, or officers to enforce protective measures in snowy plover wintering habitat.
 - 2.2.5 Protect snowy plover wintering habitat from degradation due to oil or chemical spills.
 - 2.2.6 Protect wintering habitat from degradation by removing litter manually instead of using raking machines.
- 2.3 Compensate loss of snowy plover wintering habitat associated with recovery efforts for other sensitive species.
- 2.4 Protect snowy plovers during migration.
 - 2.4.1 Identify important migration stop-over habitat.
 - 2.4.2 Identify and mitigate any factors that may be adversely affecting migratory stop-over habitat for snowy plovers.
- 3 Develop mechanisms for long-term management and protection of snowy plovers and their breeding and wintering habitat.**

- 3.1 Develop and implement regional cooperative participation networks and programs.
 - 3.1.1 Establish snowy plover working groups for each of the six recovery units.
 - 3.1.2 Develop and implement regional participation plans for each of the six recovery units.
 - 3.1.3 Provide intensive management and protection of snowy plovers on all Federal and State lands.
 - 3.1.4 Develop and implement management plans for all Federal and State lands.
 - 3.1.4.1 Develop and implement management plans for Federal lands.
 - 3.1.4.2 Develop and implement habitat conservation plans on State wildlife areas, State ecological reserves, and State beaches.
 - 3.1.5 Encourage and assist local governments and appropriate private landowners to develop and implement habitat conservation plans.
 - 3.1.6 Assist local governments in developing and implementing local land use protection measures.
 - 3.1.7 Encourage the California State Coastal Commission, the Oregon Department of Land Conservation and Development, the Washington State Parks and Recreation Commission, the Oregon Parks and Recreation Department, the California Department of Parks and Recreation, and the Oregon Department of Fish and

Wildlife to review local coastal programs and policies for consistency with the snowy plover recovery plan.

3.1.8 Obtain long-term agreements with private landowners.

3.1.9 Identify snowy plover habitat for acquisition.

3.1.10 Ensure that any section 10(a)(1)(B) and section 7(a)(2) permits contribute to Pacific coast western snowy plover conservation.

4 Undertake scientific investigations that facilitate recovery efforts.

4.1 Investigate effective and cost-efficient methods for habitat restoration by removal of introduced beachgrass.

4.2 Develop and test new predator management techniques to protect snowy plover nests and chicks.

4.2.1 Develop higher-efficiency nest exclosures.

4.2.2 Develop California least tern enclosures that prevent harm to snowy plovers.

4.2.3 Investigate ecology of native predators.

4.2.4 Investigate predator management at the landscape level.

4.2.5 Investigate techniques for identifying predators.

4.2.6 Investigate aversive methods to discourage snowy plover predators.

4.3 Improve methods of monitoring population size and reproductive success of snowy plovers.

4.3.1 Improve methods of monitoring snowy plover population size.

4.3.2 Develop sampling methods for annually estimating reproductive success.

4.3.3 Monitor snowy plover survival rates.

4.4 Identify snowy plover brood habitat and map brood home ranges.

4.5 Identify components of high-quality snowy plover brood rearing habitat.

4.6 Determine causes of adult snowy plover mortality.

4.7 Improve techniques for banding snowy plovers.

4.8 Identify effects of oil spills on snowy plovers.

4.9 Monitor levels of environmental contaminants in snowy plovers.

5 Undertake public information and education programs.

5.1 Develop and implement public information and education programs.

5.2 Inform the Federal, State, and local resource/regulatory agencies and local planning departments of threats to breeding and wintering snowy plovers and their habitats.

5.3 Develop and maintain updated information and education materials on snowy plovers.

5.4 Alert landowners and beach-goers about access restrictions within snowy plover habitats.

5.5 Provide trained personnel to facilitate protective measures, provide public education, and respond to emergency situations.

- 5.6 Develop protocols for handling sick, dislocated, injured, oiled, and dead birds or salvaged eggs.
- 5.7 Establish a distribution system and repository for information and education materials.
- 5.8 Establish a reporting and distribution system for annual monitoring data.
- 6 Review progress towards recovery annually and revise recovery efforts as appropriate.**
- 7 Dedicate U.S. Fish and Wildlife Service staff and funding for the Sacramento Fish and Wildlife Office to coordinate recovery implementation.**
- 8 Establish an international conservation program with the government of Mexico to protect snowy plovers and their breeding and wintering locations in Mexico.**
 - 8.1 Develop a joint effort between the United States and Mexico to protect snowy plover populations and their habitats.
 - 8.2 Encourage research and monitoring of breeding and wintering plovers in Baja California, Mexico, by universities and authorities of Mexico.
 - 8.3 Encourage development and implementation of public information and conservation education in Mexico for snowy plovers.

III. STEPDOWN NARRATIVE OF RECOVERY ACTIONS

1 Monitor and manage breeding habitat of the Pacific coast population of the western snowy plover to maximize survival and productivity. To assure the long-term viability of snowy plover populations, their breeding habitat should be monitored and managed in a systematic, ongoing fashion. This effort may be time-consuming, costly, and sometimes require intensive management. Western snowy plover breeding habitat is extremely dynamic and factors affecting breeding success, such as types and numbers of predators, can change quickly; therefore, managers should be prepared to modify protection as needed. Management and protection of western snowy plovers on Federal and State lands are especially important. In addition, protection on Federal and State lands furnishes leadership by example to local land managers. Land managers should recognize that components of breeding habitat include: areas where plovers prospect for nesting sites, make scrapes, lay eggs, feed, rest, and rear broods. Breeding habitat also includes travel corridors between nesting, resting, brood-rearing, and foraging areas. A summary of current and needed management activities on breeding and wintering locations is provided in Appendix C.

1.1 Monitor the snowy plover breeding population. Systematic, ongoing monitoring of breeding birds should be undertaken at the recovery-unit level to measure progress towards recovery and identify management and protection efforts that are needed.

1.1.1 Annually monitor population size and distribution at breeding locations in each recovery unit. Comprehensive range-wide window surveys of breeding locations (listed in Appendix B) should be conducted annually to determine population trends and fluctuations. The window survey described in Appendix J (Monitoring Guidelines) should be employed as the primary index of population size to minimize the probability of double-counting birds nesting at multiple locations during the same season. Window survey correction factors should be estimated (Task 4.3.1) to improve the accuracy and utility of population indices. This correction may require some banding at sites where there are currently no marked birds on which to base correction factors.

1.1.2 Monitor productivity. Key productivity data for understanding population trends (i.e., young fledged per adult male) have been obtained for the coast of Oregon since 1993, the shoreline of Monterey Bay since 1984, and the coast of San Diego County, California, since 1995. These areas encompass the majority of individuals in the northernmost, most central, and southernmost outer coast recovery units, and collection of comparable data should continue annually at these locations. Productivity, expressed as young fledged per male, should also be collected from all other recovery units; however, to minimize the banding of birds (because there are insufficient band combinations for the entire population), methods to sample productivity across the breeding range should be developed as an alternative to marking all individuals at all sites (Task 4.3.2).

1.1.3 Monitor annual survival. Useful information on the survival rates of adult and juvenile snowy plovers have been obtained for the coast of Oregon since 1991, the Monterey Bay area since 1984, and the San Diego County coast since 1994. This monitoring samples the snowy plover's range within these areas and collection of comparable data should continue annually. Monitoring annual survival rates at other selected sites within each recovery unit should also be done (Task 4.3.3).

1.1.4 Monitor snowy plover breeding activities at all breeding sites to identify factors limiting abundance of breeding birds, clutch hatching success, and chick fledging success. Monitoring numbers and reproductive success of breeding birds is necessary to identify factors detrimental to plovers and needed management adaptations. See Appendix J (Monitoring Guidelines).

1.1.5 Develop training and certification programs for snowy plover survey coordinators. Classroom and field training are required for observers who survey for snowy plovers, and before we can issue a section 10(a)(1)(A) permit. Instruction programs and materials should be developed for comparable training to occur throughout the snowy plover

range. Classroom topics should include, but not be limited to: (1) biology, ecology, and behavior of breeding snowy plovers; (2) identification of adult plovers, their young, and their eggs; (3) threats to plovers and their habitats; (4) survey objectives, protocols, and techniques; (5) regulations governing the salvage of carcasses or eggs; (6) special conditions of the existing recovery permit; and (7) other activities (e.g., banding).

Field training should include, as appropriate: (1) locating, identifying, and monitoring nests; (2) handling eggs and capturing and handling adults or chicks; (3) specifics on the target activity for which a recovery permit is to be issued, or under which an observer will work; (4) practical field exercises; and (5) field review of appropriate classroom topics.

1.1.6 Improve submittal system for monitoring data. Initially, range-wide survey data will be limited to results from two annual window surveys. As population and demographic monitoring guidelines evolve (Tasks 4.2.1, 4.2.2, and 4.2.3), a more sophisticated reporting and compiling system will be necessary. Our lead office should coordinate with researchers involved with monitoring to ensure that data collection, submittal, and entry systems remain current.

Sightings of banded snowy plovers provide information on the wintering sites of breeding birds, use of multiple sites by breeding and wintering plovers, and survival and dispersal of juveniles. In accordance with procedures of the U.S. Geological Survey, Bird Banding Laboratory, the Point Reyes Bird Observatory should continue to act as the color band coordinator for the Pacific coast population to avoid use of duplicate color banding schemes among researchers.

1.1.7 Evaluate and update lists of important breeding areas as data become available. As new breeding areas are discovered, the current list of important breeding habitats should be expanded or refined as appropriate.

1.1.8 Coordinate monitoring of snowy plovers and California least terns. Coordination with least tern monitors and managers is needed in all areas where snowy plovers share breeding sites with California least terns. Protocols for monitoring California least terns should be revised so that snowy plovers are not detrimentally affected. Human activities within some least tern colonies in southern California include monitoring by one to four people several days per week; maintenance of tern fences; predator management; site preparation; and banding/observation efforts. Human activities associated with tern monitoring must be recognized as additional disturbance to snowy plovers. Section 10(a)(1)(A) permits, issued under the authority of the Endangered Species Act for snowy plovers and least terns, should include both species where applicable. Monitoring efforts for both species should be kept separate because of differences in monitoring techniques and species' behaviors. Monitors of least terns and snowy plovers need to be aware of species' differences in nest spacing, brood-rearing, foraging behavior, time of breeding, vulnerability to disturbance, and monitoring and banding techniques.

Snowy plovers generally begin nesting 1 month before the arrival of breeding least terns; thus, tern management often begins well after snowy plovers have initiated nests. Site preparation (vegetation removal and fence construction) should be coordinated to minimize disturbance to nesting snowy plovers, and if possible to enhance breeding success for both species. Predator management should also be coordinated to benefit both species.

1.2 Maintain natural coastal processes that perpetuate high quality breeding habitat. The dynamic nature of beach strand habitats as storm-maintained ecosystems should be recognized and maintained.

1.2.1 Avoid development that will destroy or degrade snowy plover breeding habitat. Conflicts between sensitive species and property protection should be avoided by constructing houses, resorts, parking lots, access roads, bike paths, and other facilities in areas of low vulnerability to flooding and erosion and as far away from snowy plover breeding habitat

as possible. This site selection will in turn avert the need to stabilize shorelines to protect property.

Planners should weigh the economic and environmental costs of maintaining beach access in sensitive areas such as breeding habitats, and compare them with costs and environmental effects of alternative access points in less sensitive areas. Fragmentation and degradation of snowy plover breeding habitat caused by construction of walkways, piers, and other structures should also be avoided.

Beach development should be avoided through establishment of conservation easements, fee title acquisition, zoning, and other means. When beach development cannot be avoided, the following protections should be implemented: (1) construction should take place outside the nesting season, (2) developers and others should be forewarned during planning stages that stabilization of shorelines will result in additional habitat degradation and that these impacts may affect evaluation and issuance of permits under the jurisdiction of the U.S. Army Corps of Engineers or State coastal management agencies, (3) property owners (e.g., hotel or resort owners) should tailor recreational activity on the beach and dunes to prevent disturbance or destruction of nesting plovers, their eggs, and chicks, (4) lights for parking areas and other facilities should not shine on plover habitat (5) sources of noise that would disturb snowy plovers should be avoided, and (6) the establishment of predator perches and nesting sites should be avoided when designing facilities.

1.2.2 Avoid interference with natural processes of inlet formation, migration, and closure. Construction of rock jetties should be avoided when it would result in eroded beaches and sandspits. Inlet stabilization and breaches of beach or dune habitat should also be discouraged if these actions would interfere with natural inlet formation, closure, and migration processes that maintain availability of snowy plover habitat.

1.2.3 Avoid interference with natural processes of erosion and deposition of sand dunes. Sand removal and dredging should be avoided

when they would alter the natural patterns of erosion and deposition of coastal dunes. Water diversion and impoundment of creeks and rivers should be avoided when they would reduce sand delivery to beaches or interfere with maintenance of open habitat at river and creek mouths.

1.2.4 Avoid beach stabilization projects. The natural processes of overwash and blowouts that perpetuate characteristics of preferred breeding habitat should be allowed to continue unimpeded. Construction of seawalls should be avoided. Plantings of introduced beachgrass (*Ammophila* spp.), iceplant (*Mesembryanthemum* sp. and *Carpobrotus* sp.), and other nonnative vegetation for beach stabilization should be avoided.

1.2.5 Remediate and compensate the disruption of natural processes by creating and enhancing existing and potential breeding habitat. Adverse impacts to snowy plover breeding habitat from artificial beach stabilization projects should be remediated and compensated by maintaining natural long-shore sand budgets and minimizing interference with natural patterns of sand accretion and depletion. When these types of projects are planned, complex natural sand movement patterns should be taken into account. Beach management policies should recognize that many current erosion and sedimentation problems are the result of past property and/or inlet "protection" efforts. Habitat restoration projects in historic or potential breeding sites, where feasible, is encouraged. Emphasize creation of habitat in areas that would preclude or reduce recreational impacts.

1.2.5.1 Remove nonnative and other invasive vegetation from existing and potential breeding sites. Land managers should implement remedial efforts to remove or reduce vegetation that is encroaching on western snowy plover breeding habitat or obstructing movement of chicks from oceanside nesting areas to bayside feeding flats. Particular attention should be given to the eradication of introduced beachgrass (*Ammophila* spp.) within coastal dunes. Prioritized removal and control strategies for introduced beachgrass

are needed for each recovery unit. These strategies should include early intervention to prevent expansion into breeding areas where it has not yet spread or is in early stages of spreading. Attention should also be given to the removal of giant reed, Scotch broom, gorse, iceplant, and shore pine. Remove/manage vegetation on salt ponds, including levees. Schedule/coordinate removal efforts to avoid disturbing nesting snowy plovers.

1.2.5.2 Deposit dredged material to enhance or create nesting habitat, and evaluate impacts from beach nourishment activities.

Near-shore (littoral drift) and on-shore disposal of dredged material seems to be beneficial for perpetuating high quality snowy plover nesting habitat and should be encouraged. However, monitoring of habitat characteristics before, during, and after projects is needed, particularly in cases of large operations occurring on sites where snowy plovers nest or are deemed likely to nest following the disposal operation. On-shore disposal of dredged material should be scheduled outside the nesting season and, where possible, during seasons when birds are not present. In addition, dredged material must be clean sand or gravel of appropriate grain size and must be graded to a natural slope.

Beach nourishment activities should be carefully evaluated to weigh the probable adverse and beneficial effects on plovers and on other sensitive coastal dune species. Pre- and post-deposition beach profiles and faunal studies (including invertebrates) should be conducted to determine effects on habitat suitability for snowy plovers. Consideration should be given to whether the projected long-term benefits are likely to occur.

1.2.5.3 Create, manage, and enhance coastal ponds and playas for breeding habitat.

Coastal ponds and playas, including salt ponds, should be enhanced and created to improve breeding habitat. Significant opportunities for management of nesting plovers currently exist within San Francisco Bay salt ponds, Moss Landing Wildlife

Area, Bolsa Chica wetlands, and south San Diego Bay salt ponds. However, salt ponds should only be created or enhanced at existing salt pond habitat; they should not be used for mitigation or compensation of coastal beach-dune or other snowy plover habitats. Emphasize creation of habitat in areas that would preclude or reduce recreational impacts.

1.3 Prevent disturbance of breeding snowy plovers by people and domestic animals. Disturbance by humans and domestic animals causes significant adverse impacts to breeding snowy plovers. Management techniques described below can reduce impacts of beach recreation on snowy plovers, but they must be implemented annually as long as the demand for beach recreation continues. Land managers should evaluate whether recreational activities pose a threat to snowy plovers and implement appropriate enforcement measures. As information is gathered, it should be incorporated into conservation efforts. Because human disturbance is a primary factor affecting snowy plover reproductive success, land managers should give the highest priority to implementation of these management techniques. Management plans (Tasks 3.1.4.1, 3.1.4.2, and 3.1.5) should include appropriate human access and domestic animal restrictions to prevent disturbance of snowy plover breeding areas.

1.3.1 Prevent pedestrian disturbance. Management measures to protect snowy plovers should be determined on a site-by-site basis; factors to consider include the configuration of habitat as well as types and amounts of on-going pedestrian activity.

On national wildlife refuges and State natural preserves within the California State Parks system, where protection of wildlife is the paramount purpose of Federal and State ownership, snowy plover habitat should be closed during the breeding season. Other areas should also be closed when necessary to adequately protect breeding snowy plovers.

1.3.1.1 Seasonally close, fence, post, use exclosures, monitor, and enforce regulations in areas used by breeding snowy plovers as appropriate. Unless a beach is closed to public entry or use is

minimal, posting and/or fencing of nesting areas is recommended to encourage use of the area for plover courtship and prenest site selection, to prevent obliteration of scrapes, crushing of eggs or chicks, and repeated flushing of incubating adults. Fencing to keep people and beach activities out of nesting/brood rearing areas should not hinder chick movements, unless fencing is specifically meant to keep chicks from being harmed. Areas with a pattern of nesting activity in previous year(s) should be fenced or posted before plovers begin nest-site selection. Dates of seasonal closures/restrictions should be based on the best data available, and be coordinated by geographic region for consistency in communicating with the public. To provide broods with access to foraging areas, closures should cover the area down to and including the water line, where practical.

The use of exclosures (small circular, square, or triangular metal fences that can be quickly assembled) to deter predator and human intrusion is recommended as one of the most effective management tools to protect nests (see Appendix F for exclosure protocols, and Task 1.4.3). However, it should be recognized that exclosures provide nest protection, but survival of chicks to flying age cannot be ensured without prohibition of disturbance by humans and domestic animals. Symbolic fences (one or two strands of light-weight string tied between posts) with signs identifying restricted areas substantially improve compliance of beach-goers and decrease people's confusion about where entry is prohibited.

On portions of beaches that receive heavy human use during the breeding season, fencing or posting of prime brood-rearing areas to exclude or reduce numbers of pedestrians should also be implemented to contribute to the survival and well-being of unfledged chicks. Areas where territorial plovers are observed should also be closed or symbolically fenced to prevent disruption of territorial displays and courtship. Because nests can be difficult to locate, especially during egg-laying, closure of these areas will also prevent accidental crushing of undetected nests.

Land managers should monitor and enforce violations within all closed and restricted areas, with particular attention to areas where nests or broods are present.

1.3.1.2 Develop and implement necessary State and local ordinances, administrative rules, and regulations to enforce closed areas on beaches used as breeding habitat. For areas where beach closures are necessary in breeding habitat, appropriate ordinances, administrative rules, and regulations should be developed by State and local governments to enable law enforcement officers to conduct necessary enforcement actions. Local courts should uphold citations of violations of these local ordinances. Often, snowy plover habitats extend across administrative boundaries. In such cases, area law enforcement agencies are encouraged to coordinate procedures and authorities to most effectively ensure compliance. Closed areas should be posted with signs designating the State or municipal law, ordinance, or other regulation governing the closed area.

1.3.1.3 Locate access points and trails well away from snowy plover nesting habitat. Recreational users such as campers, clammers, anglers, equestrians, collectors, etc., should be encouraged to consistently use designated access points and avoid restricted areas. Roads, trails, designated routes, and facilities should be located as far away from snowy plover habitat as possible.

1.3.1.4 Implement and enforce pet restrictions. It is preferable that land managers prohibit pets on beaches and other habitats where snowy plovers are present, or traditionally nest or winter, because any noncompliance with leash laws can cause serious adverse impacts to snowy plovers. If pets are not prohibited, they should be leashed and under manual control of their owners at all times. Pets should be prohibited on beaches and other snowy plover habitats if, based on observations and experience, pet owners fail to keep pets leashed and under full control.

Land managers should document the type and frequency of infractions of rules and regulations requiring pets on leash. This information, including the number of verbal warnings, written warnings, and notices to appear (citations), should be documented so that comparisons can be made between locations. This documentation could help ensure that adequate effort is being made to enforce pet regulations.

1.3.1.5 Prevent disturbance from disruptive recreational activities where breeding snowy plovers are present. Fireworks should be prohibited on beaches where plovers nest. When fireworks displays are situated to avoid disturbance to snowy plovers, careful planning should also be conducted to assure that spectators will not walk through and throw objects into plover nesting and brood-rearing areas. Sufficient personnel must also be on-site during these events to enforce plover protection measures and prevent use of illegal fireworks in the vicinity of the birds.

Falconry and flying of kites and model airplanes should be prohibited in areas where nesting plovers are present. Sports such as ball- and frisbee-throwing should be prohibited within hitting and throwing distance of snowy plover nesting areas because of tendencies for stray balls and frisbees to land in closed areas where they can smash nests and where efforts to remove them can disturb territorial or incubating birds.

Camping and beach fires should be prohibited in snowy plover nesting areas during the nesting season.

Special events, including sporting events, media events, and beach clean-ups, attract large crowds and require special attention. Special events targeted for snowy plover nesting areas should not be held during the plover nesting season. Early planning and coordination with local resource agencies should be emphasized.

Land managers should report suspected violations of aviation regulations in snowy plover nesting areas during the breeding season. Suspected violations and the aircraft's registration number should be reported to law enforcement officers and, if appropriate, the Federal Aviation Administration. If not in violation of aviation regulations (e.g., helicopters), a description of the helicopter should be reported to law enforcement officers so they can notify the operator of the potential for take of snowy plovers in nesting areas. Aircraft operations within snowy plover habitat should require a minimum altitude of 152 meters (500 feet) for aircraft and a higher altitude for helicopters. Aircraft operations that have already established guidelines allowing aircraft to fly under the 152-meter (500-foot) threshold should raise the limits to this minimum threshold or higher as needed.

1.3.1.6 Prevent driftwood removal. Driftwood removal should not be allowed unless needed to create sufficient open habitat to induce nesting activities. In such cases, driftwood removal should occur outside of the breeding season.

1.3.1.7 Implement and enforce anti-littering regulations.

Litter should be removed from snowy plover breeding areas to avoid attracting predators. Littering ordinances should be enforced year-round. Tasks 1.4.1 and 2.2.6 emphasize the need to remove litter and garbage from beaches manually (not by raking machines) year-round to protect breeding and wintering snowy plovers. Task 1.4.1 also emphasizes that land managers should supply covered or scavenger-proof trash receptacles at access points and away from snowy plover habitat, and that receptacles should be routinely emptied. Land managers should also provide toilets at access points and away from snowy plover habitat to encourage people from using the dunes.

1.3.2 Prevent disturbance, mortality, and habitat degradation by off-road vehicles, including beach-raking machines. Recreational off-road vehicles should be prohibited or restricted at snowy plover breeding areas, as appropriate. Violations associated with unauthorized entry of recreational off-road vehicles into closed or fenced nesting areas should be strictly enforced. During the nonbreeding season, enforcement of violations regarding recreational off-road vehicle use should continue where snowy plover use of beaches occurs year-round.

Essential vehicles within snowy plover nesting areas should: (1) travel on sections of beaches where unfledged chicks are present only if absolutely necessary; (2) when possible, travel through chick habitats only during daylight hours; (3) travel at less than 8 kilometers (5 miles) per hour; (4) use a guide familiar with snowy plovers; (5) use open four-wheel motorized off-highway vehicles or nonmotorized all-terrain bicycles to improve visibility; (6) avoid driving on the wrack (marine vegetation) line and during high-tide periods; (7) travel below the high tide mark and as close to the water line as is feasible and safe; and (8) avoid previous tracks on the return trip.

Because of potential habitat degradation caused by mechanized beach cleaning, alternatives to this type of beach cleaning are recommended, including manual beach cleaning by agency staff and volunteers knowledgeable about the need to maintain coastal dune habitat characteristics and to protect snowy plovers. Task 1.4.1 emphasizes the need to remove litter and garbage from beaches manually (not by raking machines) during the nesting season, that land managers should supply covered or scavenger-proof trash receptacles at access points and away from snowy plover habitat, and that receptacles should be routinely emptied. Retain plover habitat components such as kelp and driftwood (see Task 1.3.1.6).

1.3.3 Implement and enforce restrictions on horseback riding in nesting areas. Strategies to reduce adverse impacts to nests from

commercial and private equestrian use of snowy plover habitat should include: (1) use of designated trail systems or, when absent, use of the wet sand area in areas not closed to the water line; (2) advance coordination with local resource agencies regarding locations of nests and broods; (3) compliance with closed or restricted areas; and (4) informing riders of the need for restrictions to protect habitats used by snowy plovers and other sensitive coastal dune species. Avoid high-tide periods. Violations regarding unauthorized entry into closed or restricted breeding areas by equestrians should be strictly enforced.

1.3.4 Provide wardens, agents, or officers to enforce protective measures in breeding habitat. Wardens are especially needed on heavily-used beaches during the peak recreational season, which coincides with the snowy plover breeding season in many locations. Federal, State, and local authorities should provide a coordinated law enforcement effort to eliminate activities that may adversely impact snowy plovers, such as illegally-parked vehicles, trespassing off-road vehicles, pedestrians, pets in restricted areas, falconry, illegal or unauthorized activities (e.g., fireworks, beach fires), pets off leash, and littering. Patrols and enforcement are needed to ensure compliance (e.g., Vandenberg Air Force Base linear restriction) and to make sure restrictive measures are successful. Specific actions to be implemented include patrols in protected areas (see Task 1.3.6) and car patrols to prevent illegal driving and parking.

1.3.5 Develop and implement training programs for enforcement personnel and others who work in snowy plover breeding habitat. Federal, State, and local enforcement personnel and others who work in plover habitat should be trained to conduct thorough investigations into potential violations of the Endangered Species Act and other wildlife conservation statutes. Training should be coordinated with the local Fish and Wildlife Service Law Enforcement office. It is essential that wardens, whether professional or volunteers, be thoroughly trained in procedures for conducting patrols in a manner that minimizes risk to plovers; have at least rudimentary knowledge of snowy plovers for

public education purposes; and be trained to handle potentially confrontational situations. *In cases involving take of listed species, it is essential that investigations be conducted only by trained, certified, and professional law enforcement agents.* Our local Law Enforcement office should be informed *immediately* whenever evidence of suspected take of snowy plovers is encountered.

1.3.6 Ensure that enforcement efforts do not endanger snowy plovers, their nests, eggs, or chicks. Where the extent of habitat to be protected is large, making foot patrols infeasible, horses, four-wheel all-terrain vehicles/off-road vehicles, or nonmotorized all-terrain bicycles, are preferred over trucks, automobiles, etc., because they afford improved visibility for operators. Except during emergencies, vehicle speed should not exceed 8 kilometers (5 miles) per hour and horses should be ridden at a walk only. In addition to providing maximum visibility for operators, horse and foot patrols by uniformed personnel have the added advantage of providing informational/educational interactions with beach visitors to promote compliance with plover protection measures.

Enforcement and emergency response personnel (such as search and rescue, and fire) should be well aware of potential snowy plover locations. These locations should be named as avoidance areas as a part of their plans and training exercises.

Enforcement patrols should use the same access trails as beach visitors; if additional access points are needed, they should be the minimum necessary and as far away from nesting plovers as possible.

1.4 Prevent excessive predation for snowy plovers. Land managers should employ an integrated approach to predator management that considers a full range of management techniques. Managers may need to reevaluate and clarify their policies on the management of predator populations and/or habitat where predation might be limiting local snowy plover populations. In particular, policies that prohibit management of native predator populations,

even when human-abetted factors have caused substantial increases in their abundance, may be counter-productive to the overall goal of protecting "natural" ecosystems.

In addition to predator management activities by on-site biologists, assistance from the U.S. Department of Agriculture (Wildlife Services Branch) biologists, State wildlife agency furbearer biologists, biologists specializing in avian predators, and professional trappers should be sought and used as needed and appropriate. Federal, State, and local agencies and the general public should be cognizant of the adverse consequences to listed species if needed predator control measures are prohibited or restricted.

1.4.1 Remove litter and garbage from beaches manually, not by raking machines. Beachgoers should be discouraged from leaving or burying trash or food scraps on the beach. Trash cans should not be located on the beach unless there is no other recourse to prevent littering. If trash cans have to be placed on the beach, predator-proof trash containers should be used. Until predator-proof trash containers can be installed, existing trash cans should be emptied frequently to reduce attractiveness and availability of their contents to scavenging predators. Emptying cans in the evening instead of leaving them overnight is preferable. Fish-cleaning stations should be located well away from plover breeding areas.

Although removal of trash from the beach reduces predation threats, beach-raking should be avoided year-round to protect breeding and wintering snowy plovers. Trash should be selectively removed from the beach manually, but natural materials, including shells, seaweed, and driftwood, should be left intact.

In areas where large amounts of nonnative woody debris, such as giant reed (*Arundo donax*), has washed onto beaches and significantly reduced the amount of nesting habitat, a large portion of the debris (but not all) should be removed. However, this removal should not be done during the nesting season.

1.4.2 Remove predator perches and unnatural habitats. Planners should not allow unnatural habitats to be placed near snowy plover nesting locations. Where feasible, land managers should remove from plover breeding locations any exotic vegetation, perches, and other features that attract avian and mammalian predators. Where signs and fences are necessary as part of management to protect plover breeding areas, attempts should be made to design them in a way that will deter their use by predators (e.g., install spikes on fence posts).

1.4.3 Erect predator exclosures to reduce snowy plover egg predation where appropriate. Current guidelines for the use of predator exclosures to protect nesting snowy plovers are contained in Appendix F. Exclosures are a valuable tool for countering human-abetted predation threats to snowy plover eggs, but they are not appropriate for use in all situations, nor do they provide any protection for mobile plover chicks, which generally leave the exclosure within 1 day of hatching and move extensively along the beach to feed. Exclosures should be used in conjunction with an integrated predator management program. Also, exclosures must be carefully constructed, monitored, and evaluated by qualified persons. String (twine) may be needed on top of exclosures to deter avian predators.

1.4.4 Remove predators where warranted and feasible. Removal of predators should be pursued where it is feasible, warranted, humanely conducted, and useful. Situations that may especially warrant predator removal include those where nonnative predators such as red fox (*Vulpes vulpes regalis*), feral cats, and Norway rats (*Rattus norvegicus*) are present, where predators have been introduced to islands, where predator range extensions have been human-abetted, or where high rates of snowy plover adult, chick, or egg predation (which cannot be countered with predator exclosures) are occurring. Nonnative predators should be eliminated in all instances from plover nesting habitat. Native predators should be removed or controlled by nonlethal means whenever possible.

Federal and State permits must be obtained to legally capture, kill, or hold and release birds protected under the Migratory Bird Treaty Act and State laws. Also, individuals responsible for capturing such birds and the holding facility must have the proper Federal and State permits, and Federal land managers must document that such activities are in compliance with the National Environmental Policy Act. Biological considerations for determining whether removal of avian predators is appropriate include the time of year (to assess whether the predator is caring for young or is a fledgling itself), whether the predatory bird is a resident or migrating through snowy plover nesting habitat, and whether the predatory bird is a sensitive species or listed under the Endangered Species Act. Because of the potential for swift and significant losses of plovers by avian predators, land managers should plan in advance to complete the necessary procedures and secure needed permits to effectively deal with cases of high negative impact on plovers. Removal of native predators should focus on problem individuals rather than populations. State permits must also be obtained to capture and relocate mammals (e.g., raccoons, skunks, and opossums).

Gulls should be discouraged from establishing and expanding nesting colonies at snowy plover nesting areas, and land managers should determine whether existing gull colonies warrant removal. At some sites, placement of crow and gull carcasses around plover nest site perimeters may discourage these predators. Therefore, attempts should be made to try scare gulls (i.e., gull carcasses for deterrents) prior to removal of gulls. If removal is not warranted, exclosures around plover nests should be used to prevent large flocks of roosting gulls from trampling plover nests.

1.4.5 Remove bird and mammal carcasses in snowy plover nesting areas. Where practical and not disturbing to snowy plovers, dead birds and mammals that wash up on the beach in close proximity to plover nests should be removed to reduce the attraction of predators to plover nests. Removal of carcasses of marine mammals and species listed under the Endangered Species Act should be coordinated with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service.

1.5 Protect snowy plovers and their breeding habitat from oil or chemical spills. Land managers should develop oil/chemical spill emergency response plans that provide for protection of known plover breeding areas. The U.S. Coast Guard should update their emergency response measures to include protective measures for the snowy plover. In the event of a spill in the vicinity of a snowy plover nesting or feeding area, efforts should be made to prevent oil/chemicals from reaching these beaches. Clean-up operations should be prompt, but agencies should exercise special care during remediation efforts and coordinate closely with us to prevent accidental destruction of nests and/or excessive disturbance of breeding adults, nests, or chicks. Response plans should include applicable recommendations contained in this recovery plan (e.g., Task 1.3.2 regarding essential vehicles).

If snowy plovers or their habitat sustain injury due to oil/chemical spills, the responsible parties should restore the areas to their original condition or the Federal Government (U.S. Coast Guard) should lead the clean-up effort; appropriate claims should also be filed under the Natural Resource Damage Assessment regulations to recover damages and undertake relevant restoration work. Assessment of natural resource damages is facilitated by availability of baseline data on pre-spill conditions. Therefore, whenever possible, agencies that own or manage snowy plover habitat should collect baseline data on behavior, reproduction, distribution, abundance, and habitat use. The baseline information on plover distribution and habitat use should also be supplied to the Area Committees that develop and update regional spill contingency plans so that this information can be incorporated into pre-spill planning efforts for protection of sensitive environments and species.

Oil spill emergency response personnel should be well aware of potential plover locations. These locations should be named as avoidance areas as a part of their training exercises.

1.6 Replace exotic dune plants with native dune vegetation where it is likely to improve breeding habitat for snowy plovers. Land managers should make special efforts to reestablish native dune plants in snowy plover nesting habitat, while concentrating on removal of nonnative vegetation.

Native dune vegetation includes American dunegrass (*Leymus mollis*), beach morning glory (*Calystegia soldanella*), pink sand-verbena (*Abronia umbellata*), yellow sand verbena (*Abronia latifolia*), beach bursage (*Ambrosia chamissonis*), grey beach pea (*Lathyrus littoralis*), whiteleaf saltbush (*Atriplex leucophylla*), and California saltbush (*Atriplex californica*). These efforts should be targeted for coastal dune sites that currently support nonnative vegetation species such as introduced beachgrass (*Ammophila* spp), and should be combined with removal of this invasive plant (see Task 1.2.5.1). Seeds of local native dune plants collected within approximately 32 kilometers (20 miles) of the site to be planted should be used as replacement plant stock. Revegetation efforts should be monitored to make sure they that the amount of vegetative cover is compatible with suitable breeding habitat for plovers.

1.7 Compensate the loss of snowy plover breeding habitat associated with recovery efforts for other sensitive species, including those within the San Francisco Bay Recovery Unit. When snowy plover breeding habitat will be adversely affected by management and recovery actions for other sensitive species, all efforts should be made to conserve snowy plover habitat. Where this is not possible, any loss of snowy plover habitat values should be fully compensated. Within coastal beach-dune habitats in Washington, Oregon, and California, compensation efforts should emphasize the removal of beachgrass (*Ammophila* spp.) for lost snowy plover breeding habitat resulting from management for other sensitive species.

To compensate for the loss of existing snowy plover breeding habitat values in San Francisco Bay from planned conversion to tidal marsh, appropriate salt ponds should be designated for protection and enhancement as snowy plover breeding habitat. Currently, most snowy plover breeding habitat occurs on levee roads, margins of active salt ponds, and pond bottoms of inactive salt ponds. Roads and levees provide lower quality habitat because of disturbance and ease of predator access. Any losses of snowy plover breeding habitat should be replaced with habitat that provides similar or higher values (i.e., salt ponds or salt pans) in concert with recovery actions implemented from the Central and Northern California Coast Tidal Marsh Recovery Plan (U.S. Fish and Wildlife Service in prep.). Habitat enhancement for snowy plovers should

be phased in with scheduled tidal marsh restoration for other listed species. During this interim period, land owners should make all efforts to achieve the recovery criteria of 500 breeding adults within the San Francisco Bay Recovery Unit by intensively managing existing snowy plover breeding habitat.

Replacement of snowy plover breeding habitat in San Francisco Bay should concentrate on areas where the necessary components of plover breeding habitat can be created. These areas include locations where unvegetated salt pans, salt ponds, islets and levees, and tidal mudflats/sandflats can be created or enhanced. Also, attempts should be made to avoid areas that are adjacent to landfills or other high concentrations of potential predators. Unless it is shown to be infeasible, creation and enhancement of snowy plover breeding habitat should be emphasized in areas that currently support high numbers of breeding plovers and/or are not conducive to salt marsh restoration, including the Oliver Brothers salt ponds (north and south of Highway 92), Alviso salt ponds, other salt pond systems between the San Mateo Bridge and Redwood Creek, Napa salt ponds, and the Redwood City and Napa crystallizers. The area to be managed for plovers should be sufficient to support a population of 500 breeding birds, estimated at 809 hectares (2,000 acres) of managed salt ponds. Most of these managed salt ponds should be located in South San Francisco Bay, which supports most of the existing snowy plover population; however, some should also be located in the North Bay. Created or enhanced salt ponds should be intensively managed, similar to the Moss Landing Wildlife Area salt ponds. Management measures practiced at these salt ponds include maintenance of water control structures to maintain desired water levels, removal of excessive vegetation, and predator control.

1.8 Discourage pinnipeds from usurping snowy plover nesting areas.

Land managers should monitor pinniped colonies adjacent to snowy plover breeding habitat and seek to keep breeding pinnipeds from occupying snowy plover nesting areas during the plover breeding season. Where conflicts occur, breeding pinnipeds should be discouraged from hauling out at plover breeding areas or be relocated, if feasible. Implementation of this task should be coordinated with the National Marine Fisheries Service to ensure

compliance with the Endangered Species Act of 1973 and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1361-1407).

2 Monitor and manage wintering and migration areas to maximize snowy plover population survival. Wintering and migration habitats should be monitored and managed to maximize survival and recruitment of snowy plovers into the breeding population.

2.1 Monitor known and potential wintering locations. All known wintering locations (listed in Appendix B of this plan) are considered currently important to snowy plover conservation. These sites include both wintering locations that currently support breeding birds and locations that may potentially support nesting birds in the future. These locations may also support migrating snowy plovers. There is a need for better information about wintering sites, including spatial and temporal use patterns, feeding areas, habitat trends, and threats.

2.1.1 Monitor snowy plover abundance and distribution at wintering locations in each recovery unit. Comprehensive range-wide window surveys of wintering locations listed in Appendix B should be conducted annually to determine population trends and fluctuations (Appendix J, Monitoring Guidelines).

2.1.2 Identify factors limiting the quality of wintering locations. Land managers should monitor the response of snowy plovers to potentially adverse factors at wintering locations (listed in Appendix B), including natural coastal formation processes, dredging, and other channel maintenance projects. Opportunities to incorporate monitoring into Federal activities subject to section 7 of the Endangered Species Act, such as dredging and discharges regulated by the U.S. Army Corps of Engineers, should be sought. Impacts of recreational use by humans and their pets should also be monitored.

2.1.3 Quantify wintering habitat needs of snowy plovers along the Pacific coast. The amount of habitat needed to support wintering snowy

plovers along the Pacific coast should be determined. This effort should include estimating the numbers of snowy plovers that can be supported at wintering locations listed in Appendix B and identifying important site characteristics. This task will require consideration of wintering habitat capacity along the Pacific coast of the United States and Mexico, and quantifying the combined interior and coastal populations.

2.1.4 Evaluate and update lists of important wintering areas as data become available. As new snowy plover wintering areas are discovered and data needed to assess the carrying capacity, essential characters, and juxtaposition of wintering habitats become available, the current list of important wintering locations should be expanded or refined as appropriate.

2.2 Prevent human degradation and disturbance of wintering habitat. The Pacific coast population of the western snowy plover is sensitive to changes in adult and juvenile survival rates (see Appendix D). Furthermore, recovery of this species is contingent on availability of wintering habitat for more than the current number of snowy plovers (see recovery criteria).

2.2.1 Protect wintering habitat from impacts of water diversion/impoundment and shoreline stabilization, navigation, and development projects. Coastal development, beach stabilization, resource extraction, and water diversion and/or impoundment projects should be carefully assessed for impacts to wintering snowy plovers. Recommendations from Fish and Wildlife Service offices (under the Endangered Species Act and Clean Water Act) and/or State agencies should focus on avoiding or minimizing adverse impacts to wintering habitat. Where adverse effects cannot be avoided, agencies should document impacts so that cumulative effects on this species' habitat can be assessed and compensated.

2.2.2 Protect wintering habitat from disturbance by people and domestic animals. Snowy plover wintering sites are highly variable in their amount of recreational activity. Land managers should conduct site-

specific evaluations to determine whether recreational activities, domestic animals, and off-road vehicles pose a threat to plovers. Appropriate protection and enforcement measures should be incorporated into conservation efforts. Management plans (Tasks 3.1.4.1, 3.1.4.2, and 3.1.5) should include appropriate human/domestic animal access restrictions to prevent disturbance of snowy plovers.

2.2.3 Develop and implement necessary State and local ordinances, administrative rules, and regulations to enforce closed areas on beaches used as snowy plover wintering habitat. For areas where beach closures are necessary in wintering habitat, appropriate ordinances, administrative rules, and regulations should be developed by State and local governments to enable law enforcement officers to conduct necessary enforcement actions. Often, snowy plover wintering habitat extends across administrative boundaries. In such cases, area law enforcement agencies are encouraged to coordinate procedures and authorities to most effectively ensure compliance. Closed areas should be posted with signs designating the State or municipal law, ordinance, or other regulation that is being violated.

2.2.4 Provide trained wardens, agents, or officers to enforce protective measures in snowy plover wintering habitat. Wardens should be used to enforce protective measures on snowy plover wintering habitat. Enforcement personnel and others who work in plover habitat should be trained to conduct thorough investigations into potential violations of the Endangered Species Act and other wildlife conservation statutes.

2.2.5 Protect snowy plover wintering habitat from degradation due to oil or chemical spills. Efforts must be made to minimize the likelihood of oil or chemical spills in plover wintering areas. Land managers should develop oil/chemical spill emergency response plans that provide for protection of known plover wintering areas. The U.S. Coast Guard should update their emergency response measures to include protective measures for the snowy plover. Shorebird or coastal ecosystem protection plans

developed by State or local agencies to address oil/chemical spills should also include protection measures for snowy plovers. In the event of a spill in a known snowy plover wintering area, efforts should be made to prevent oil/chemicals from impacting plovers and unavoidable impacts should be documented. Restoration efforts should begin expeditiously, but agencies should exercise special care and coordinate closely with us to prevent excessive disturbance to wintering snowy plovers.

If snowy plovers or their habitats sustain injury due to oil/chemical spills, the responsible parties should restore the areas to their original condition or the Federal Government (U.S. Coast Guard) should lead the clean-up effort; appropriate claims should also be filed under the Natural Resource Damage Assessment regulations to recover damages and undertake relevant restoration work. Assessment of natural resource damages is facilitated by availability of baseline data on pre-spill conditions; therefore, whenever possible, agencies that own or manage snowy plover habitat should collect baseline data on behavior, distribution, abundance, and habitat use by plovers. The baseline data should also be supplied to the area committees that develop and update regional spill contingency plans so that this information can be incorporated into pre-spill planning efforts for protection of sensitive environments and species.

2.2.6 Protect wintering habitat from degradation by removing litter from beaches manually, instead of using raking machines. Beach-raking of snowy plover wintering habitat should be avoided because it removes plover food sources. Trash should be selectively removed from the beach manually, but natural materials, including shells, seaweed, and driftwood, should be left intact.

2.3 Compensate the loss of snowy plover wintering habitat associated with recovery efforts for other sensitive species. When snowy plover wintering habitat will be adversely affected by management and recovery actions for other sensitive species, all efforts should be made to conserve snowy plover habitat. Where conservation of habitat is not possible, any loss of snowy plover habitat should be fully compensated.

2.4 Protect snowy plovers during migration. Additional information on snowy plover migration patterns is needed because migration involves expenditure of energy that may affect survival or productivity. Although monitoring and protection of breeding and wintering locations are currently higher priorities than protection of migration sites, further investigations of, and protective measures for, migration sites should be undertaken when feasible.

2.4.1 Identify important migration stop-over habitat. Identify any important migration stop-over areas used by migrating but not by breeding or wintering snowy plovers.

2.4.2 Identify and mitigate any factors that may be adversely affecting migratory stop-over habitat for snowy plovers. Further investigations of factors that may affect the well-being of snowy plovers during migratory stop-overs should be investigated and mitigated, particularly at sites that receive heavy use or face threats to their suitability as stop-over habitat.

3 Develop mechanisms for long-term management and protection of snowy plovers and their breeding and wintering habitat. Long-term management and protection will be needed on Federal and nonFederal lands. Development of long-term protection mechanisms should include opportunities for participation of various stakeholders in development of management options.

3.1 Develop and implement regional cooperative participation networks and programs. Development of regional cooperative networks and programs, coordinating local public and private land use planning with State and Federal land use planning, recovery planning, and biodiversity conservation is needed. From these networks and programs, participation plans (see Task 3.1.2) should be developed and implemented to expedite and increase the chances of recovery for the western snowy plover (see Figure 12, flow chart of recovery planning and implementation efforts).

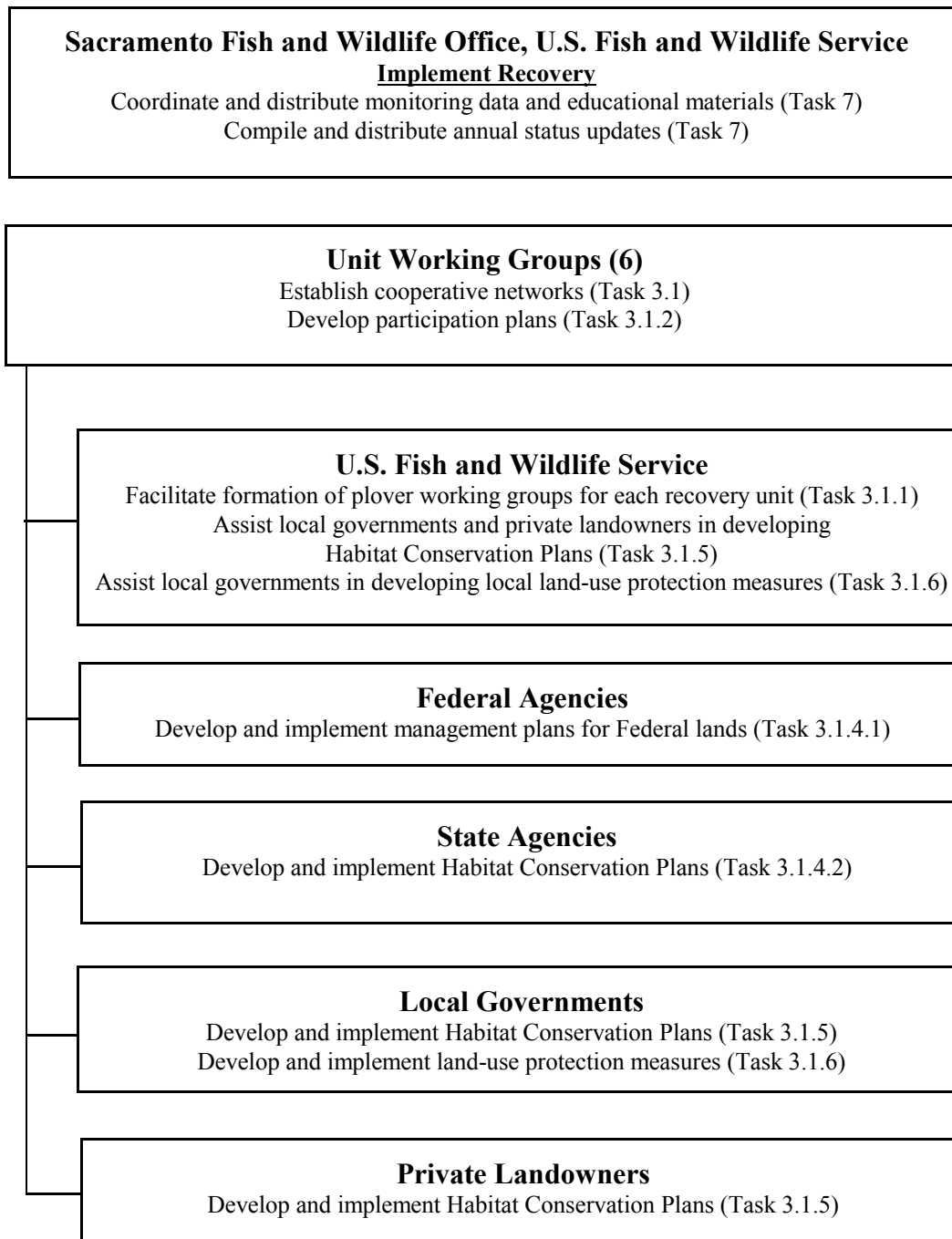


Figure 12. Flow chart of recovery planning and implementation efforts.

3.1.1 Establish snowy plover working groups for each of the six recovery units. To facilitate regional cooperative programs, working groups should be established for each of the six recovery units, covering the following areas: (1) Oregon and Washington; (2) northern California (Del Norte, Humboldt, and Mendocino Counties); (3) San Francisco Bay (locations within the counties of Napa, Alameda, Santa Clara, and San Mateo); (4) Monterey Bay (including coastal areas along the counties of Monterey, Santa Cruz, San Mateo, San Francisco, Marin, and Sonoma); (5) San Luis Obispo, Santa Barbara, and Ventura Counties; and (6) Los Angeles, Orange, and San Diego Counties. Working groups should be patterned after the Western Snowy Plover Working Teams for Oregon and Monterey Bay. The Teams should be composed of representatives from the Federal, State, local, and private sectors; and meet regularly to assess snowy plover population trends and coordinate plover recovery efforts. Each of the six working groups should use this recovery plan as a guide, but members will prioritize what management measures need to be implemented in their recovery unit because they have on-the-ground, day-to-day, experience about what is currently being done in these areas. Public outreach should also be a major focus of the working groups. An interchange of ideas between all six working groups should also occur on an on-going basis.

The following U.S. Fish and Wildlife Service field offices should facilitate the formation of new working groups and exchange of information among working groups: (1) Western Washington Fish and Wildlife Office, Lacey, Washington; (2) Newport Fish and Wildlife Office, Newport, Oregon; (3) Arcata Fish and Wildlife Office, Arcata, California; (4) Sacramento Fish and Wildlife Office, Sacramento, California; (5) Ventura Fish and Wildlife Office, Ventura, California; and (6) Carlsbad Fish and Wildlife Office, Carlsbad, California.

3.1.2 Develop and implement regional participation plans for each of the six recovery units. Participation plans should be developed by each of the six recovery unit working groups to implement recovery actions and

maintain the snowy plover populations, after delisting. Plans should identify and prioritize specific recovery activities for each location identified in Appendix B, while considering the needs of the entire Pacific coast population. They should include, but not be limited to: (1) endorsements by responsible agencies of their intent to seek economic resources for ongoing recovery actions; (2) outreach efforts to enhance the public's understanding of the snowy plover's habitat needs (including an information and education strategy specific to area demographics and recreational activities); (3) economic incentives for conservation of snowy plovers on private lands; and (4) all actions necessary to maintain snowy plover productivity after delisting. Participation plans may also identify ways in which recovery actions for snowy plovers will be covered as part of coastal ecosystem plans or other conservation measures.

3.1.3 Provide intensive management and protection of snowy plovers on all Federal and State lands. Federal and State land managers should protect and intensively manage all breeding and wintering locations (listed in Appendix B) that occur on Federal and State lands. Intensive management programs for snowy plovers at national wildlife refuges should be implemented and annually evaluated to ensure they provide sufficient plover protection. Intensive management programs should also be implemented and periodically evaluated on lands administered by the National Park Service, U.S. Forest Service, U.S. Bureau of Land Management, U.S. Army Corps of Engineers, and Federal military bases, State wildlife areas, State ecological reserves, and State park lands (including State natural preserves and State seashores).

3.1.4 Develop and implement management plans for all Federal and State lands. Federal and State land managers should develop and implement management plans for all breeding and wintering locations (listed in Appendix B).

3.1.4.1 Develop and implement management plans for Federal lands. Federal agencies should develop or update, as appropriate, site-

specific management plans that address threats to snowy plovers, and adopt management measures for habitat protection and enhancement on Federal lands. Management plans should be implemented on an ongoing basis. Federal agencies should also review their proposed actions under the requirements of sections 7 and 10 of the Endangered Species Act prior to implementing the management plans because they may require authorization under section 7(a)(2) or 10(a)(1)(A).

3.1.4.2 Develop and implement habitat conservation plans on State wildlife areas, State ecological reserves, and State beaches.

State agencies that manage State beaches, wildlife areas, or ecological reserves should develop and implement site-specific habitat conservation plans to minimize and mitigate impacts to snowy plovers, and management measures for habitat protection and enhancement on State lands. State agencies should coordinate the development of habitat conservation plans with us and apply for section 10(a)(1)(B) permits under the Endangered Species Act if their management actions and allowed uses are resulting in incidental take of snowy plovers.

3.1.5 Encourage and assist local governments and appropriate private landowners to develop and implement habitat conservation plans. We should provide assistance in the development of habitat conservation plans to: (1) county and city governments that manage snowy plover habitats; (2) private resource managers; and (3) owners of large amounts of private natural land. Habitat conservation plans are only required if an incidental take permit under section 10(a)(1)(B) of the Endangered Species Act is desired or required.

3.1.6 Assist local governments in developing and implementing local land use protection measures. Federal and State agencies should assist local governments in developing snowy plover protection policies as part of new or revised local general plans, zoning policies, implementing measures, land use plans, comprehensive plans, and local coastal programs. Technical assistance such as maps of snowy plover habitats,

identification of local threats, and recommended site-specific protective measures should be provided to coastal planners.

3.1.7 Encourage the California State Coastal Commission, the Oregon Department of Land Conservation and Development, the Washington State Parks and Recreation Commission, the Oregon Parks and Recreation Department, the California Department of Parks and Recreation, and the Oregon Department of Fish and Wildlife to review local coastal programs and policies for consistency with the snowy plover recovery plan. We should encourage the California State Coastal Commission, Oregon Department of Land Conservation and Development, Washington State Parks and Recreation Commission, Oregon Parks and Recreation Department, California Department of Parks and Recreation, and Oregon Department of Fish and Wildlife to review local coastal programs and policies for consistency with the snowy plover recovery plan. This review should include protection of snowy plover habitats, cumulative impacts to snowy plovers, and policies or restrictive measures recommended in this recovery plan.

We should encourage and assist the California Coastal Commission and Oregon Department of Land Conservation and Development to ensure that Local Coastal Plans, Local Comprehensive Plans, and Implementing Measures for coastal planning jurisdictions are updated, through periodic review or plan amendment, to reflect the recovery plan. Encourage the California Coastal Commission to implement its Regional Cumulative Assessment Program. We should also work with the Oregon Parks and Recreation Department to ensure coordination between Local Comprehensive Plans and that agency's management of the ocean shore and to evaluate and account for cumulative impacts across planning jurisdictions.

We should coordinate with the Oregon Department of Fish and Wildlife during their periodic statutory review of the Oregon Endangered Species Act, to assure consistency with this recovery plan.

3.1.8 Obtain long-term agreements with private landowners.

Agreements between Federal and State agencies and private landowners interested in snowy plover conservation should be developed and implemented. Landowners should be apprised of the significance of plover populations on their lands and be provided with information about available conservation mechanisms, such as agreements and incentive programs. For private lands with potential occurrences of snowy plovers, permission should be sought from landowners to conduct on-site surveys. If surveys identify plover populations, landowners should be apprised of their significance and offered incentives to continue current land uses that support species habitat.

3.1.9 Identify snowy plover habitat for acquisition. Federal, State, and private conservation organizations should acquire snowy plover habitat as it becomes available, through fee title or conservation easement, etc. We and other organizations should identify sites that may become available for acquisition, and we should continue to evaluate excess Federal lands for snowy plover habitat and apply to acquire them as they become available. Each recovery unit working group should develop a list of priority properties for acquisition, and Federal, State, and nongovernmental organizations should work with land conservancy groups to implement land trades and acquisitions.

3.1.10 Ensure that section 10(a)(1)(B) and section 7(a)(2) permits contribute to Pacific coast western snowy plover conservation.

Recommendations contained in this recovery plan should guide the preparation of habitat conservation plans under section 10(a)(1)(B) of the Endangered Species Act for snowy plovers on the Pacific coast by providing information to: (1) guide potential applicants in developing plans that minimize and mitigate the impacts of take and (2) assist us in evaluating the impacts of any proposed conservation plans on the recovery of the Pacific coast snowy plover population. The recovery plan should also guide the evaluation of impacts to snowy plovers under section 7(a)(2) permits issued pursuant to the Endangered Species Act. In evaluating these impacts, we and other Federal agencies should consider each of the breeding and wintering

locations listed in Appendix B as important for recovery, and should also refer to the management goal breeding numbers for applicable locations and determine how the proposed project will affect those goals. No short-term or long-term losses to plover habitats should be allowed. The section 10(a)(1)(B) permit process may be a valuable mechanism for developing the long-term protection agreements called for in Tasks 3.1.4.2 and 3.1.5, especially where significant population growth has already occurred and productivity exceeds 1.0 fledged chick per male.

4 Undertake scientific investigations that facilitate recovery efforts. Major gaps remain in our understanding of useful protection measures and conservation efforts.

4.1 Investigate effective and cost-efficient methods for habitat restoration by removal of introduced beachgrass. Land managers should summarize methods used to date for removal of introduced beachgrass. They should also pursue field studies to determine the most effective and cost-efficient methods for habitat restoration through removal of introduced beachgrass. Controlled studies with improved monitoring would provide needed direction for management decisions.

4.2 Develop and test new predator management techniques to protect snowy plover nests and chicks. Because many of the techniques currently used to reduce predation have disadvantages or limitations in effectiveness, new predator management techniques should be investigated. Assistance from the U.S. Department of Agriculture, Wildlife Services Branch, from State wildlife agency furbearer biologists, and other predatory bird and mammal specialists should be sought on these matters.

4.2.1 Develop higher-efficiency nest exclosures. Because exclosures must be deployed quickly, and currently-designed exclosures are heavy and labor- and time-intensive to erect, new exclosure designs should be tested. Prototypes should include lightweight materials that are easier to transport and a design that is easy to assemble and install.

4.2.2 Develop California least tern enclosures that prevent harm to snowy plovers. Resource managers should investigate modified designs for California least tern enclosures to minimize snowy plover mortality. These modifications should include mesh sizes that do not ensnare plover chicks and allow them to move freely in and out of fenced areas. Fences must be erected prior to the snowy plover nesting season.

4.2.3 Investigate ecology of native predators. The ecology of problematic avian predators (e.g., ravens and shrikes) and native mammals (e.g., coyotes and gray foxes) should be investigated to gain an understanding of how to control their impact on snowy plover nesting areas during the plover breeding season.

4.2.4 Investigate predator management at the landscape level. Resource managers should investigate landscape-level management of predators in the vicinity of snowy plover nesting areas. This management could include removal of predator nest sites on lands surrounding snowy plover breeding areas.

4.2.5 Investigate techniques for identifying predators. Techniques should be developed to identify predators so that appropriate management measures can be applied. Such techniques could include installation of a remote video camera to monitor snowy plover nests and exclosures and identify problematical predators.

4.2.6 Investigate aversive methods to discourage snowy plover predators. Information is needed on the applicability and usefulness of aversive techniques for conditioning predators not to prey on snowy plover eggs, chicks, or adults. Aversive techniques may include taste aversions, displaying predator carcasses, or installing electric fences. Effective modifications of signs and fencing to prevent their use as predator perches also requires investigation. While there seem to be obstacles to development of effective aversion techniques that can be efficiently applied in the field, there are substantial potential advantages to be realized from aversive techniques that can reduce predation with minimum

disruption to native predator populations that are important to overall ecosystem balance, and that might be conducted at times when plovers are not present.

4.3 Improve methods of monitoring population size and reproductive success of snowy plovers. Methods used to monitor snowy plover populations have differed over time and from site to site. To measure progress toward recovery reliably, standard monitoring guidelines have been developed (Appendix J). Logistical and financial constraints likely will preclude complete coverage of all areas, so sampling methods should be developed.

4.3.1 Improve methods of monitoring snowy plover population size. Not all plovers at a given location are detected during a single survey, such as the annual breeding-season window survey. Consequently, correction factors are necessary to extrapolate population size from window surveys. Correction factors are determined on a site-specific basis. Intensive monitoring and/or color banding make it possible to know the number of plovers present at a site. When a window survey is completed, the ratio of the total number of plovers to the number of plovers counted provides a correction factor that may be used for future window surveys of the site and for other sites with window surveys but without intensive monitoring. Site-specific correction factors should be obtained for all major nesting locations. When correction factors have been determined for many sites, patterns may emerge that allow correction factors to be applied more broadly.

4.3.2 Develop sampling methods for annually estimating reproductive success. While it is extremely valuable to monitor clutch hatching success and chick fledging success at each site as a measure of habitat quality, it is critical to determine the number of young fledged per male for each recovery unit to measure the potential for population stability and growth. Measuring the number of young fledged per male requires intensive monitoring, and at sites with large numbers of birds, some method of identifying individual males. Extensive color banding of adults and their young, enabling determination of young fledged per male,

has been undertaken in large portions of coastal Oregon, the shoreline of Monterey Bay, and coastal San Diego County for the past several years. These efforts should continue. Since there are insufficient color band combinations to monitor all individuals in every recovery unit, sampling procedures should be developed to color band adequate samples of males, and if necessary their chicks, in the other recovery units to obtain estimates of the number of young fledged per male. Color banding for measuring reproductive success should be integrated with banding for estimating population size.

4.3.3 Monitor snowy plover survival rates. Extensive color banding of adult plovers and their young in coastal Oregon, the shoreline of Monterey Bay, and coastal San Diego County has enabled survival rates of adults and young to be calculated for several years (see Population Status and Trends and Survival sections). These efforts should continue. Information on survival rates of birds from other recovery units can be derived from birds banded for monitoring reproductive success or estimating population size.

4.4 Identify snowy plover brood habitat and map brood home ranges. Brood movements should be mapped and distances quantified to identify how large an area must be protected for broods. Traditionally-used brood habitat should be identified and protected. Determine home ranges of snowy plovers through radio telemetry studies.

4.5 Identify components of high-quality snowy plover brood rearing habitat. The elements of high-quality brood habitat should be determined to facilitate creation and enhancement of suitable characteristics at other breeding locations.

4.6 Determine causes of adult snowy plover mortality. Determine causes of mortality and the stage in the annual cycle (e.g., post-breeding, migration, winter, pre-breeding, breeding) at which mortality occurs for each sex and age class. This assessment can be done through intensive, bi-weekly monitoring

to determine relative health and potential for disease. Monitoring could include fat content and weight related to the season.

4.7 Improve techniques for banding snowy plovers. Improve the technique for banding birds to reduce injuries. Because plover injuries are usually associated with Federal metal bands but not with plastic bands, removal of U.S. Fish and Wildlife Service lettering from the inside of the metal band should be investigated. Eliminating use of the U.S. Fish and Wildlife Service metal band should also be considered. Experimentation with new techniques must be conducted cautiously and may need to include pre-testing on nonlisted surrogate species.

4.8 Identify effects of oil spills on snowy plovers. Research should be conducted on the direct and indirect effects of oil spills on snowy plovers, including, but not limited to: (1) how oil spills affect the plover's prey base; (2) chronic effects of oiling; (3) transmission of oil on partially-oiled birds from the breast to the egg; (4) at what stage oiled plovers need to be captured or re-captured; (5) preferable methods to remove oil from soiled birds; and (6) impacts to plovers during oil clean-up and remediation activities.

4.9 Monitor levels of environmental contaminants in snowy plovers. When abandoned eggs and/or dead chicks that are not needed for law enforcement investigations become available, they should be collected for potential contaminants assessment. Egg removal and salvage of dead chicks should only be done by individuals possessing proper Federal and State authorizations. Chemical analysis of salvaged specimens should be coordinated through our Division of Environmental Contaminants. All salvaged eggs should be analyzed for organochlorine pesticides, total polychlorinated biphenyls (PCB's), selenium, mercury, and boron.

All sampling should be opportunistic, based on availability of eggs that are known to be abandoned. Eggs should never be removed from the beach as long as there is any realistic chance that they might hatch. In the case of unhatched eggs from a partially hatched clutch, eggs should not be collected until at least 36 hours after the known hatch date of the other eggs. Full

clutches should not be collected unless it is known that 35 or more days have elapsed since the last egg was laid.

5 Undertake public information and education programs. Expanded efforts are needed to increase public awareness of the needs of snowy plovers, other rare beach species, and the beach and dune ecosystem. Public outreach efforts should be a major focus of each of the working groups for the six recovery units.

5.1 Develop and implement public information and education programs.

Millions of beach recreationists come in contact with snowy plover nesting and wintering areas each year. Disregard to signs, symbolic fencing, and leash laws by beach users can directly affect the productivity and health of snowy plovers on those beaches. Public information and education efforts play a key role in obtaining compliance of beach recreationists with plover protection measures that, in turn, affect the birds' recovery. Central messages to the beach-going public include: (1) respect areas fenced or posted for protection of plovers and other rare beach species; (2) do not approach or linger near snowy plovers or their nests; (3) if pets are permitted on beaches used by plovers, keep the pets leashed; (4) don't leave or bury trash or food scraps on beaches, as garbage attracts predators that may prey upon plover eggs or chicks; and (5) do not build wood structures that can be used as predator perches.

Because of the importance of information and education for the snowy plover recovery effort, as part of this recovery plan, we developed an Information and Education Plan for the Western Snowy Plover, Pacific coast Population (Appendix K).

5.2 Inform Federal, State, and local resource/regulatory agencies and local planning departments of threats to breeding and wintering snowy plovers and their habitats. Periodic meetings and/or workshops should be held to inform Federal, State, and local resource management and regulatory agencies, and city and county planning departments about threats, research, and management needs for plovers. A network of public agency staff from each of the six recovery unit working groups should develop a coordinated

approach to present this information to these agencies periodically, or as needed.

5.3 Develop and maintain updated information and education materials on snowy plovers. Members of the six recovery unit working groups should develop new snowy plover information and education materials for target audiences to stimulate public interest and awareness. In addition, all materials should be kept reasonably current regarding the status of the species and protection efforts. These materials should also explain the need for conservation of the beach and dune ecosystem and the plight of other rare beach-dwelling species. Videos detailing needed snowy plover recovery actions by location and recovery unit should be developed, and might be efficiently produced in conjunction with updated public service advertisements.

5.4 Alert landowners and beach-goers about access restrictions within snowy plover habitats. Land managers should begin providing informational and educational outreach at least 2 weeks prior to the onset of the nesting season to provide beach-goers and interested landowners with advance notice of impending restrictions on publicly-owned snowy plover breeding habitats. This outreach is particularly important for the first year of restrictions. If necessary, follow-up publicity that includes information on citations issued to violators should be implemented to help reinforce the message.

5.5 Provide trained personnel to facilitate protective measures, provide public education, and respond to emergency situations. Biologists, docents, volunteers, and other personnel should be trained to patrol snowy plover nesting areas to monitor birds, distribute educational materials, respond to emergency situations, and ensure that beach-goers stay out of fenced areas and adhere to other plover protection measures. Biologists engaged in monitoring, management, or research activities should also advance the public's understanding of plover management needs.

5.6 Develop protocols for handling sick, dislocated, injured, oiled, and dead birds or salvaged eggs. Land managers within each recovery unit

should develop protocols for all trained personnel identifying who should be contacted when injured, dead, oiled, or dislocated birds are found, and who is permitted to handle these birds. Federal and State salvage permits are necessary for the disposal of dead birds and the transportation of injured birds. Federal and State endangered species permits are necessary for wildlife rehabilitators to accept and care for injured and sick birds. Coordination with biologists that are monitoring and banding snowy plovers is essential for capture and release of injured/rehabilitated birds. Live chicks that are found should not be moved or taken for rehabilitation as these chicks are often not abandoned, even though plover adults may not be obvious at the time the chicks are seen. Protocols should also be developed on how to collect and preserve salvaged eggs used for contaminants analysis.

5.7 Establish a distribution system and repository for information and education materials. Land managers must distribute information and education materials to target audiences. To reach the large population of potential beach-goers within a few hours' drive of many major metropolitan areas, broad-scale information and education mechanisms should be implemented, including distribution by mass media such as newspapers, radio and television announcements, and internet web sites. Land managers should also focus their information and education efforts on user groups at beach parking lot entry stations and kiosks, visitor centers, marinas, beach-front housing developments, equestrian and angler access points, and locations providing off-road vehicle permits. Public outreach efforts should be directed to groups within the geographical location of the managed beaches (e.g., to private and commercial equestrian users) and to groups outside of the area who use the beaches on a regular or seasonal basis (e.g., to off-road vehicle associations from out-of-state or inland locations). Land managers, with the help of docents and volunteers, should coordinate with local school teachers to develop and present environmental education lesson plans and participatory activities for elementary and middle school groups.

We will act as a central repository for current and new information and education materials received; upon request, we will make these materials available to recovery unit working groups and the general public. We will

also maintain information on snowy plovers at our website (www.rl.fws.gov). Major distributional efforts should also continue by Federal, State, and local agencies, and private conservation organizations.

5.8 Establish a reporting and distribution system for annual monitoring data. Our Sacramento Fish and Wildlife Office should coordinate and produce an annual report of submitted breeding and wintering monitoring data and distribute it to recovery unit working groups. This report should describe results of monitoring throughout the snowy plover population's range.

6 Review progress towards recovery annually and revise recovery efforts as appropriate. Communication, evaluation, and coordination play a major role in snowy plover recovery efforts. Land managers within each of the six recovery unit working groups should review the effectiveness of their management activities in coordination with other members of their working group, and revise management measures as appropriate. They should also provide results of annual population monitoring and the effectiveness of management activities to their working group and to our Sacramento Fish and Wildlife Office.

7 Dedicate U.S. Fish and Wildlife Service staff and funding for the Sacramento Fish and Wildlife Office to coordinate snowy plover recovery implementation. We should assure the availability of long-term funding for a staff position in the Sacramento Field and Wildlife Office, the lead field office responsible for preparation and implementation of this recovery plan. The primary responsibility of this staff position is implementation of the snowy plover recovery plan. Duties should include coordination and distribution of monitoring information and educational materials; transmission of copies of annual population monitoring results to our field offices that are responsible for snowy plover issues; compilation and distribution of annual population status updates to all working groups; coordination with our other field offices in Region 1 regarding snowy plover conservation actions, consultations, habitat conservation plans, and permits; facilitating establishment of, and coordination among, the working groups created for the six recovery units; and fund raising to support recovery implementation actions.

8 Establish an international conservation program with the government of Mexico to protect snowy plovers and their breeding and wintering locations in Mexico. Meeting the recovery goals outlined in this recovery plan is dependent only on actions recommended for implementation along the Pacific coast of the United States. However, other tasks are identified for Mexico to complement conservation efforts in the United States. Efforts should be made to establish an international conservation program between the U.S. Fish and Wildlife Service and Mexico's National Institute of Ecology, Ministry of Environment, Natural Resources and Fisheries. Programs to facilitate implementation of this conservation program should include Partners in Flight, North American Waterfowl Management Plan, and the Borderlands Initiative.

8.1 Develop a joint effort between the United States and Mexico to protect snowy plover populations and their habitat. Joint efforts should be implemented to determine important habitat in Mexico and protect these breeding and wintering locations from human disturbance.

8.2 Encourage research and monitoring of breeding and wintering snowy plovers in Baja California, Mexico, by universities and authorities of Mexico. Joint efforts should be made to develop and implement a long-term monitoring program for snowy plover populations of Mexico. They should include developing methods for consistent monitoring, coordination of banding and color-marking with banders from the United States, assessment of the population status of breeding and wintering birds, and assessment of environmental impacts that may adversely affect plover populations.

8.3 Encourage development and implementation of public information and conservation education in Mexico for snowy plovers. Public information and educational efforts should be coordinated and implemented by the United States and Mexico. They should include development of bilingual pamphlets for distribution to anglers, tourists, and local communities, and construction and placement of bilingual signs alerting them of the presence of nesting snowy plovers.

IV. IMPLEMENTATION

The following Implementation Schedule outlines actions needed and responsible parties for the recovery program in the United States portion of the Pacific coast population of the western snowy plover over the next 5 years and over the estimated 25-year period needed for its recovery. Considering the recovery criteria, results of the population viability analysis (Appendix D), and fulfillment of the recommendations contained in the recovery plan, recovery of the snowy plover could occur in 20 to 35 years. With dedicated, proactive efforts toward improvements in snowy plover management in the near-term, and subsequent management at a maintenance level commensurate with fulfillment of the recovery criteria, the recovery team estimates recovery would occur in approximately 25 years.

Total costs that could be projected are \$28,588,000, representing the recovery team's best estimate of funds needed to implement certain tasks over a 25-year period. However, these costs only represent a portion of the overall costs because the cost of many other tasks cannot be estimated at this time. For example, costs associated with the key and costly task requiring intensive protection and management on Federal and State lands (Task 3.1.3) should be determined by members of each of the six recovery unit working groups.

It should be recognized that expenditure of funds for recovery of the snowy plover will provide far-reaching benefits beyond those gained for a single species. Allocation of these funds will also benefit many other sensitive fish and wildlife species, the coastal beach-dune ecosystem, public appreciation for natural habitats, and aesthetics. These estimated costs do not reflect a cost/benefit analysis that incorporates other values or economic effects with implementation of the recommendations contained in this recovery plan.

We believe that protection and management costs could be substantially reduced by selecting protection strategies that are more restrictive of other beach uses. While we believe that it is neither feasible nor desirable to completely eliminate beach recreation in most snowy plover habitat, it also recognizes that management strategies that protect plovers on beaches where public use is also maintained require a continuing commitment of person-power, and are inherently expensive.

The Implementation Schedule lists and ranks tasks that should be undertaken within the next 5 years. This schedule will be reviewed annually until the recovery objective is met, and priorities and tasks will be subject to revision. Tasks of higher priority are presented first.

Referenced tasks in the “Comments/Notes” column are explained in the Stepdown Narrative section.

Key to Acronyms used in the Implementation Schedule

Definition of task priorities:

Priority 1 - An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population or habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Definition of task durations and costs:

Annual - A task that will be implemented each year.

Continual - A task that will be implemented on a routine basis once begun.

Ongoing - A task that is currently being implemented and will continue until action is no longer necessary.

As needed - A task that will be implemented on an “as needed” basis.

Unknown - Either task duration or associated costs are not known at this time.

To Be Determined (TBD): Costs to be determined at a later date.

Responsible parties*:

ARMY	U.S. Army
BLM	U.S. Bureau of Land Management
CCC	California State Coastal Commission
CDFG	California Department of Fish and Game
CDPR	California Department of Parks and Recreation
CE	U.S. Army Corps of Engineers
CI	Cities
CO	Counties
EBRPD	East Bay Regional Park District
ES	U.S. Fish and Wildlife Service, Division of Ecological Services (includes Endangered Species and Contaminants)
FAA	U.S. Department of Transportation, Federal Aviation Administration
HARD	Hayward Area Recreation and Park District
IA	U.S. Fish and Wildlife Service, Office of International Affairs
LE	U.S. Fish and Wildlife Service, Division of Law Enforcement
LMAO	Land Management Agencies and Organizations and other Cooperators. This category includes Federal and local land management agencies listed above, private organizations and individuals that own and manage snowy plover breeding and wintering habitat, and private conservation groups that provide on-site protection of lands owned by others.
MPOSD	Mid-Peninsula Open Space District
MPRPD	Monterey Peninsula Regional Park District
NASA	National Aeronautics and Space Administration-Ames Research Center
NAVY	U.S. Navy
NMFS	National Marine Fisheries Service
NPS	National Park Service
ODFW	Oregon Department of Fish and Wildlife
ODLCD	Oregon Department of Land Conservation and Development
OPRD	Oregon Parks and Recreation Department
P	Private landowners (except HARD, MPOSD, and TNC)
PA	U.S. Fish and Wildlife Service, Public Affairs
PGH	Port of Grays Harbor
PO	Port of Oakland

PRBO	Point Reyes Bird Observatory
PSL	Port of San Luis Harbor District
RSCH	Research institutions and agencies
RW	U.S. Fish and Wildlife Service, Division of Refuges and Wildlife (includes Realty)
SDRPJPA	San Dieguito River Park Joint Powers Authority
TNC	The Nature Conservancy
TPL	Trust for Public Land
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
BBL	U.S. Geological Survey, Bird Banding Laboratory
BRD	U.S. Geological Survey, Biological Resources Division
USMC	U.S. Marine Corps
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WS	U.S. Department of Agriculture, Wildlife Services Branch
WSPRC	Washington State Parks and Recreation Commission

* All responsible parties listed for tasks in Implementation Schedule are considered lead agencies for those tasks.

IMPLEMENTATION SCHEDULE
Western Snowy Plover Pacific Coast Population Recovery Plan

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
1	Annually monitor population size and distribution at breeding locations in each recovery unit.	1.1.1	annual	LMAO, CO, CI	1,000	40	40	40	40	40	100 window survey days, at \$192 per biologist day, 2 biologists per breeding location. Task needed to determine fulfillment of recovery criteria.
1	Monitor productivity.	1.1.2	annual	LMAO, CO, CI	See Task 1.1.4						Part of Task 1.1.4. Task implementation needed to ascertain fulfillment of recovery criteria.
1	Monitor snowy plover breeding activities at all breeding sites to identify factors limiting abundance of breeding birds, clutch hatching success and chick fledging success.	1.1.4	annual	LMAO	16,000	640	640	640	640	640	Needed for adaptive management.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
1	Avoid development that will destroy or degrade plover breeding habitat.	1.2.1	ongoing	ES, LMAO, CO, CI	Unknown						Contingent on number and types of projects proposed.
1	Avoid interference with natural processes of inlet formation, migration, and closure.	1.2.2	ongoing	ES, CE, LMAO	Unknown						Contingent on number and types of projects proposed.
1	Avoid interference with natural processes of erosion and deposition of sand dunes.	1.2.3	ongoing	ES, CE, LMAO	Unknown						Contingent on number and types of projects proposed.
1	Avoid beach stabilization projects.	1.2.4	ongoing	ES, CE, LMAO	Unknown						Contingent on number and types of projects proposed.
1	Remove nonnative vegetation from existing and potential breeding sites.	1.2.5.1	continual	LMAO	TBD						Incorporate into ongoing management and Task 3.1.3. Cost range for mechanical, manual and/or chemical control: \$1000 to \$87,000 per hectare (\$400 to \$35,000 per acre).

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
1	Create, manage and enhance coastal ponds and playas for breeding habitat.	1.2.5.3	ongoing	ES, RW, CE, CDFG, NASA, HARD, LMAO	TBD						Incorporate into ongoing management. See Task 1.7.
1	Seasonally close, fence, post, use exclosures, monitor and enforce regulations in areas used by breeding snowy plovers as appropriate.	1.3.1.1	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Cost estimate for symbolic fencing: Materials (posts/cables): \$5,900 per kilometer (\$9,500 per mile); Labor: 15 person hours per kilometer (24 person hours per mile).
1	Develop and implement necessary State and local ordinances, administrative rules and regulations to enforce closed areas on beaches used as breeding habitat.	1.3.1.2	continual	ES, LE, LMAO, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD, WDFW, WDNR, WSPRC, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Cost estimate for ordinance signs: \$20 per sign through California Prison Industries. Need one introductory sign at each access point; one sign every 100 meters (328 feet) at closure areas with symbolic fence; and two signs (one 50 meters (164 feet)) north and one 50 meters south of enclosure.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
1	Locate access points and trails well away from plover nesting habitat.	1.3.1.3	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
1	Prevent disturbance from disruptive recreational activities where breeding snowy plovers are present.	1.3.1.5	annual	LMAO, CO, CI, FAA	TBD						Incorporate into ongoing management and Task 3.1.3.
1	Prevent disturbance, mortality, and habitat degradation by off-road vehicles, including beach-raking machines.	1.3.2	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Approximately \$53,000 spent on management of Pismo Dunes State Vehicular Recreation Area. Expect cost savings with manual removal of trash due to equipment and fuel cost savings.
1	Provide wardens, agents or officers to enforce protective measures in breeding habitat.	1.3.4	continual	LE, LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Cost depends on intensity of use.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
1	Erect predator exclosures to reduce egg predation where appropriate.	1.4.3	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Cost estimates for exclosures: Materials (wire, posts): \$105 per unit; Tools (one-time cost): \$30 per kilometer (\$48 per mile); Labor: 6 person hours for installation/removal per unit.
1	Remove predators where warranted and feasible.	1.4.4	as needed	LMAO, CO, CI, WS, CDFG	2,500	100	100	100	100	100	Incorporate into ongoing management and Task 3.1.3.
1	Protect snowy plovers and their breeding habitat from oil or chemical spills.	1.5	as needed	LMAO, CO, CI, USCG	Unknown						Incorporate into ongoing management and Task 3.1.3. Costs contingent on number and magnitude of spills.
1	Protect wintering habitat from degradation due to oil or chemical spills.	2.2.5	as needed	ES, USCG, LMAO	Unknown						Incorporate into ongoing management and Task 3.1.3. Contingent on number and magnitude of spills.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
1	Establish snowy plover working groups for each of the six recovery units.	3.1.1	continual	ES, LMAO, CO, C I, P	2,285	96	96	91	91	91	Essential mechanism to advance plover recovery. Includes biannual meeting costs and \$5,000 during FY1 and FY2 for FWS field office staff to establish new working groups.
1	Provide protection and intensive management of all breeding and wintering locations on Federal and State lands.	3.1.3	continual	RW, ARMY, BLM, CE, NASA, NAVY, NPS, USAF, USFS, USMC, CDFG, CDPR, ODFW, OPRD, WDFW, WDNR, WSPRC	TBD						PVA shows that intensive management is needed for recovery. Represents other tasks; costs should be determined through working groups.
1	Dedicate U.S. Fish and Wildlife Service staff and funding for the Sacramento Fish and Wildlife Office to coordinate recovery implementation.	7	continual	ES	2,000	80	80	80	80	80	

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
2	Ensure that enforcement efforts do not endanger snowy plovers, their nests, eggs or chicks.	1.3.6	continual	LE, LMAO, CO, CI	See Task 1.3.5						Part of Task 1.3.5.
2	Replace exotic dune plants with native dune vegetation where it is likely to improve breeding habitat for snowy plovers.	1.6	continual	LMAO, CO, CI	TBD						Concentrate on removal of nonnative vegetation (Task 1.2.5.1). Estimated cost for planting native vegetation: \$30,000 per hectare (\$12,000 per acre) for planting, re-planting, and follow-up costs.
2	Compensate the loss of plover breeding habitat associated with recovery efforts for other sensitive species, including those within the San Francisco Bay recovery unit.	1.7	ongoing	ES, RW, CE, LMAO	TBD						For San Francisco Bay recovery unit, this task should be phased in (see Task 1.7).

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
2	Protect wintering habitat from impacts of water diversion/ impoundment and shoreline stabilization, navigation, and development projects.	2.2.1	ongoing	ES, CE, LMAO, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD, WDFW, WDNR, WSPRC CO, CI	Unknown						Contingent on number and types of projects proposed.
2	Compensate the loss of plover wintering habitat associated with recovery efforts for other sensitive species.	2.3	ongoing	ES, RW, CE, LMAO	TBD						
2	Develop and implement regional participation plans for each of the six recovery units.	3.1.2	continual	ES, LMAO	TBD						Essential mechanism to advance snowy plover recovery (see Task 3.1.2 in step-down narrative).

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
2	Assist local governments in developing and implementing local land use protection measures.	3.1.6	ongoing	ES, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD, WDNR, WDFW, WSPRC, CO, CI	TBD						
2	Investigate effective and cost-efficient methods for habitat restoration by removal of introduced beachgrass.	4.1	continual	ES, LMAO, RSCH	TBD						
2	Develop higher-efficiency nest exclosures.	4.2.1	ongoing	ES, LMAO, RSCH	20	10	5	3	2	0	Compare new exclosures with current ones to determine effects on snowy plovers.
2	Develop California least tern enclosures that prevent harm to snowy plovers.	4.2.2	as needed	ES, USMC, CDFG, CDPR, LMAO, RSCH	TBD						Costs specific to sites with California least tern enclosures. Estimated cost for materials (fencing/posts): \$7 per linear foot (\$23 per meter).

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
2	Improve methods of monitoring population size.	4.3.1	continual	ES, LMAO, RSCH	TBD						Part of Tasks 1.1.1, 1.1.2 and 1.1.3.
2	Develop sampling methods for annually estimating reproductive success.	4.3.2	as needed	ES, RSCH	30	5	25	0	0	0	
2	Develop and implement public information and education programs.	5.1	ongoing	ES, PA, LMAO	TBD	TBD	TBD	TBD	TBD	TBD	Depends on individual recovery unit strategies. See Appendix K (Information & Education Plan) for estimates of component expenses.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
2	Review progress towards recovery annually and revise recovery efforts as appropriate.	6	continual	ES, RW, ARMY, BLM, CE, NASA, NAVY, NPS, USAF, USFS, USMC, CDFG, CDPR, ODFW, ODPR, WDFW, WDNR, WSPRC, LMAO	1,150	46	46	46	46	46	Preparation and follow-up efforts needed for Task 3.1.1.
3	Monitor annual survival.	1.1.3	continual	LMAO, RSCH	TBD						Do concurrently with Task 4.2.3.
3	Develop training and certification programs for snowy plover survey coordinators.	1.1.5	continual	ES, LMAO, RSCH	TBD						
3	Improve submittal system for monitoring data.	1.1.6	continual	ES, LMAO, BBL, PRBO	575	23	23	23	23	23	Needed to coordinate bands and compile data.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Evaluate and update lists of important breeding areas as data become available.	1.1.7	continual	LMAO	TBD						
3	Coordinate monitoring of snowy plovers and California least terns.	1.1.8	annual	ES, RW, NAVY, USMC, USAF, CDFG, CDPR, WS, BRD	450	18	18	18	18	18	Coordinate at biannual pre- and post-season California least tern monitoring meeting.
3	Deposit dredged material to enhance or create nesting habitat, and evaluate impacts from beach nourishment activities.	1.2.5.2	as needed	ES, CE, LMAO	TBD						
3	Implement and enforce pet restrictions.	1.3.1.4	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Prevent driftwood removal.	1.3.1.6	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Implement and enforce anti-littering regulations.	1.3.1.7	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Implement and enforce restrictions on horseback riding in nesting areas.	1.3.3	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Develop and implement training programs for enforcement personnel and others who work in plover breeding habitat.	1.3.5	continual	LE, LMAO, CO, CI	200	8	8	8	8	8	Annual training cost estimate: \$8,000 per year.
3	Remove litter and garbage from beaches manually, not by raking machines.	1.4.1	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Remove predator perches and unnatural habitats.	1.4.2	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Remove bird and mammal carcasses in snowy plover nesting areas.	1.4.5	as needed	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Discourage pinnipeds from usurping snowy plover nesting areas.	1.8	as needed	NPS, LMAO, NMFS	TBD						Specific to sites that attract breeding pinnipeds.
3	Monitor snowy plover abundance and distribution at wintering locations in each recovery unit.	2.1.1	annual	LMAO, CO, CI	575	23	23	23	23	23	57 window survey days at \$192 per biologist day, 2 biologists per wintering location.
3	Identify factors limiting the quality of wintering locations.	2.1.2	continual	LMAO, CO, CI	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.
3	Quantify wintering habitat needs of snowy plovers along the Pacific coast.	2.1.3	continual	LMAO, RSCH	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Evaluate and update lists of important wintering areas as data becomes available.	2.1.4	continual	ES, LMAO	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.
3	Protect wintering habitat from disturbance by people and domestic animals.	2.2.2	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Develop and implement necessary State and local ordinances, administrative rules and regulations to enforce closed areas on beaches used as wintering habitat.	2.2.3	annual	ES, LMAO, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD, WDFW, WDNR, WSPRC, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. See Task 1.3.1.2 for unit costs of ordinance signs.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Provide wardens, agents or officers to enforce protective measures in wintering habitat.	2.2.4	continual	LE, LMAO, CO, CI	100	4	4	4	4	4	Annual training cost estimate: \$4,000/year.
3	Protect wintering habitat from degradation by removing litter from beaches manually, not by raking machines.	2.2.6	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Identify important migration stop-over habitat.	2.4.1	continual	ES, LMAO	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.
3	Identify and mitigate any factors that may be adversely affecting migratory stop-over habitat for snowy plovers.	2.4.2	continual	ES, LMAO, RSCH	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Develop and implement management plans for Federal lands.	3.1.4.1	ongoing	RW, ARMY, BLMCE, NASA, NAVY, NPS, USAF, USMC, USFS	TBD						
3	Develop and implement Habitat Conservation Plans on State wildlife areas, State ecological reserves, and State beaches.	3.1.4.2	continual	CDFG, CDPR, ODFW, OPRD, WDFW, WDNR, WSPRC	TBD						
3	Encourage and assist local governments and appropriate private landowners to develop and implement Habitat Conservation Plans.	3.1.5	ongoing	ES, CO, CI, P, EBRPD, HARD, MPOSD, MPRPD, PGH, PO, SL, TNC, SDRPJPA	TBD						

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Encourage the California State Coastal Commission, the Oregon Department of Land Conservation and Development, the Washington State Parks and Recreation Commission, the Oregon Parks and Recreation Department, the California Department of Parks and Recreation, and the Oregon Department of Fish and Wildlife to review local coastal programs and policies for consistency with snowy plover recovery plan.	3.1.7	as needed	ES, CCC, ODLCD, ODFW, OPRD, CDPR, WSPRC	TBD						

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Obtain long-term agreements with private landowners.	3.1.8	as needed	ES, CDFG, CDPR, ODFW, OPRD, WDFW, WSPRC, LMAO, P	TBD						
3	Identify habitat for acquisition.	3.1.9	ongoing	ES, RW, LMAO	TBD						
3	Ensure that any section 10(a)(1)(B) and section 7(a)(2) permits contribute to Pacific coast western snowy plover conservation.	3.1.10	ongoing	ES, Federal agencies	TBD						
3	Investigate ecology of native predators.	4.2.3	as needed	ES, RW, LMAO, WS, CDFG, RSCH, CO, CI, P	150						Annual expenditures (FY1 through FY5) TBD.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Investigate predator management at the landscape level.	4.2.4	as needed	ES, RW, LMAO, WS, RSCH, CO, CI, P	150						Annual expenditures (FY1 through FY5) TBD.
3	Investigate techniques for identifying predators.	4.2.5	continual	LMAO, RSCH	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.
3	Investigate methods to deter predators from using signs and fencing as predator perches.	4.1.7	as needed	LMAO, RSCH	TBD						
3	Investigate aversive methods to discourage snowy plover predators.	4.2.6	as needed	ES, LMAO, RSCH	TBD						
3	Monitor plover survival rates.	4.3.3	continual	ES, LMAO, RSCH	TBD						Do concurrently with Task 1.1.3.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Identify brood habitat and map brood home ranges.	4.4	continual	ES, LMAO, RSCH, CO, CI, P	See Task 1.1.4						Part of Task 1.1.4.
3	Identify components of high-quality brood rearing habitat.	4.5	continual	ES, LMAO, RSCH, CO, CI, P	900						Requires 3-year intensive study at 4-6 sites in WA, OR and CA. Annual expenditure (FY1 through FY5) TBD.
3	Determine causes of adult snowy plover mortality.	4.6	ongoing	LMAO, RSCH	See Task 1.1.4						Part of Task 1.1.4.
3	Improve techniques for banding snowy plovers.	4.7	ongoing	RSCH, PRBO, BRD, BBL	3						Part of Task 1.1.4. Total estimated cost to produce new bands: \$3,000.
3	Identify effects of oil spills on snowy plovers.	4.8	as needed	RSCH, BRD, LMAO	TBD						

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Monitor levels of environmental contaminants in snowy plovers.	4.9	as needed	ES, RSCH, BRD	TBD						Depends on number and type of samples. Cost range: \$80-600 per sample depending on type of contaminant.
3	Apprise Federal, State and local resource/ regulatory agencies and local planning departments of threats to breeding and wintering snowy plovers and their habitats.	5.2	continual	ES, LMAO, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD, WDFW, WDNR, WSPRC, CO/CI	TBD						
3	Develop and maintain updated information and education materials on snowy plovers.	5.3	ongoing	ES, PA, LMAO, CO, CI	TBD						Incorporate into ongoing management and Tasks 3.1.3 and 5.1. See Appendix K

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Alert landowners and beach-goers about access restrictions within snowy plover habitats.	5.4	ongoing	ES, PA, LMAO, CO, CI	TBD						Incorporate into ongoing management and Tasks 3.1.3 and 5.1. See Appendix K
3	Provide trained personnel to facilitate protective measures, provide public education, and respond to emergency situations.	5.5	continual	LMAO, CO, CI	TBD						Need to secure funds for volunteer coordinator and staff to train volunteers. Incorporate into Tasks 3.1.3. and 5.1. See Appendix K.
3	Develop protocols for handling sick, dislocated, injured, oiled, and dead birds or salvaged eggs.	5.6	as needed	LMAO, CO, CI	TBD						Accomplish through section 10(a)(1)(A) permit.
3	Establish a distribution system and repository for information and education materials.	5.7	continual	ES, LMAO, CO, CI	TBD						Incorporate into ongoing management and Tasks 3.1.3, 5.1, and 7. See Appendix K.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Establish a reporting and distribution system for annual monitoring data.	5.8	annual	ES	500	20	20	20	20	20	
3	Develop a joint United States and Mexico effort to protect snowy plover populations and their habitat.	8.1	continual	ES, IA	TBD						
3	Encourage research and monitoring of breeding and wintering snowy plovers in Baja California, Mexico by universities and authorities of Mexico.	8.2	continual	ES, IA, RSCH, BRD	TBD						

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in \$1,000 units)					Comments/Notes
						FY1	FY2	FY3	FY4	FY5	
3	Encourage development and implementation of public information and conservation education in Mexico.	8.3	continual	ES, IA, PA	TBD						

Total Cost of Recovery through 2025: \$28,588,000 plus additional costs that cannot be estimated at this time.

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